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THE

INSECT HUNTER'S COMPANION.

BY THE

REV. JOSEPH GREENE, M.A.

BEING INSTRUCTIONS FOR

Collecting & Preserving Butterflies, Moths, Beetles, Bees, Flies, &c.

REVISED AND EXTENDED BY A. B. FARN

WITH AN APPENDIX BY L. N. STANILAND

SIXTH EDITION

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PREFACE TO THE FIFTH EDITION.

This, the Fifth Edition of the 'Insect Hunter's Companion,' is completed, but, alas! the hand which penned the First Edition of this little work is stilled for ever. Never again can the kind friend, ever ready to impart information to those seeking it of him, lend a sympathetic ear to the enquiries of the tyro. It would have pleased him could he but have known that the information he put in print, written in his own pleasant and unassuming way so many years ago, is still appreciated by the embryo entomologists who read his book.

The endeavour here to bring the information up to date in as terse a manner as possible has necessitated the re-writing and the addition of certain paragraphs; but it has been sought to leave untouched as far as possible the information as first given; (1) because I could not improve the manner of giving; and (2) I should wish that the memory of the late Rev. Joseph Greene should live long, not only with his contemporaries, but that it should be transmitted through many generations of Entomologists yet to come.

"The sweet remembrance of the just
Shall flourish when he sleeps in dust."

1907. A. B. FARN.

INSECT HUNTER'S COMPANION

These instructions are offered to those who, commencing the study of Entomology, are desirous of further knowledge of the various modes of capturing, setting, and preserving insects. It should, at the outset, be understood that originality is not claimed for them on the one hand, nor, on the other, superiority over other methods. This confession will, it is hoped, disarm hostile criticism. It is believed, however, that these instructions include all methods essential to a successful pursuit of Entomology; and while it is obvious that many of the methods set forth may be modified according to circumstance and the taste of the collector, yet they have at least this merit, that they have borne the test of actual experience.

BUTTERFLIES AND MOTHS.

Lepidoptera, as is well known, pass through four separate stages of existence—the egg, the larva, the pupa, and the imago. They may be captured in each of these stages.

THE EGG.

Searching.—The eggs are deposited on the various trees, shrubs, plants, flowers, leaves, &c., on which the larva is afterwards to feed. Eggs of some of the butterflies may be obtained by carefully watching the females; in this way eggs of *Apatura iris* and of *Polyommatus phlœas* have been obtained, and the same plan may be pursued as regards the females of the Notodontas and the Geometers. Owing to their minute size it is almost impossible to find eggs laid on low-growing plants.

They may, however, after a little experience, be easily detected on the leaves, flowers and seeds of various conspicuous plants. I may mention, in particular, *Angelica sylvestris* (wild angelica), growing in woods; *Clematis vitalba* (common traveller's joy), *Galium* (bedstraw), *Linaria vulgaris* (yellow toad-flax), *Lychnis dioica* (campion), *Pimpinella saxifraga* (burnet saxifrage), *Silene inflata* (bladder campion), *Solidago virgaurea* (golden rod), &c. The eggs of different species of the genus *Eupithecia* have been found on these plants, but the whole of the genus *Dianthœcia* may be taken on the various kinds of *Silene* and *Lychnis*. Judging from experience, the eggs of Bombyces and Geometræ are those generally found, especially the former. Among others, the eggs of the following species have been found, viz., *Smerinthus ocellatus* on sallow and poplars, *S. populi* on poplars, *Sphinx ligustri* on privet and ash, *Chœrocampa elpenor* on *Galium*, *Macroglossa stellatarum* on honeysuckle, *Trichiura cratægi* on twigs of hawthorn, *Dicranura furcula* on sallow, *D. vinula* and *D. bifida* on poplar and aspen, *Pygæra bucephala* on birch and lime, *Ptilophora plumigera* on maple, *Ptilodontis palpina* on poplar and aspen, *Notodonta camelina* on various trees, *N. cucullina* on maple, *N. dictæa* on poplars, *N. dictæoides* on birch, *N. dromedarius* on birch, alder, and hazel, *N. ziczac* on poplar and sallow, *N. trepida* on oak, *Cymatophora or* on poplar, *Tethea subtusa* on poplar, &c. Eggs of *Eriogaster lanestris* are laid on twigs of whitethorn and on blackthorn, and are covered with mouse-coloured down; while those of *Bombyx neustria* are laid in rings round twigs of fruit and other trees. The eggs of *A. caja* may often be found in patches on reeds in the fens. The most practical way of finding eggs is to examine the young shrubs of the different trees. A twig or small branch is taken in the hand and turned round, so as to get at the under side of the leaves, which must be carefully examined. The eggs are almost invariably deposited on the *under* side of the leaf. The genus *Dicranura*, however, is an exception. *D. furcula*, *D. bifida* and *D. vinula* all lay their eggs on the *upper* side, and, being black or dark brown, are easily detected. I have most frequently found eggs on such shrubs as are isolated in open places in woods, on or about the banks of railway cuttings, barren places in general, and in hedgerows bordering on woods. The great advantage of egg-hunting is the escaping those odious ichneumons which, in the larva and pupa state, so often blight the collector's legitimate hopes. It is stated, however, that the eggs themselves are sometimes stung. If this be true, it is indeed "nipping one's hopes in the egg (bud)." Upon the whole, egg-hunting, perhaps, is not very productive, but it may still while away an hour or two.

Boxing Female Moths.—The most certain method of obtaining eggs, however, is by boxing the female moths we may catch; and these, if placed in large chip boxes, or in perforated zinc cylinders, and supplied with twigs or leaves of the plants on which out of doors they would oviposit, may frequently be induced to lay. Those species which lay their eggs in crevices may often be induced to deposit by placing a piece of crumpled muslin in the box. Female butterflies may be induced to lay their eggs if enclosed in muslin-covered glass cylinders, made by cutting the tops off glass shades such as are used for covering stuffed birds, artificial flowers, &c. ("nests" of these may be obtained from wholesale glass vendors), placed over growing plants on which the larvæ feed. Sunshine is essential to induce the butterflies to deposit their eggs. Females of *Apatura iris*, enclosed on a broad-leaved sallow bush by leno, will lay their eggs, and the pupæ may be taken out in June the following year.

Pairing Insects.—Another mode to obtain eggs is by inducing insects, when bred in captivity, to pair. With some insects this is easily done, it being only requisite to place the male and female together in a gauze-covered box. Amongst others, as almost certain to pair, may be mentioned, *Clostera curtula*, *C. reclusa*, *C. anachoreta*, *Trichiura cratægi*, *Pœcilocampa populi*, *Dicranura furcula*, *D. bifida*, *D. vinula*, *Amphidasys prodromaria* and *A. betularia*, &c. On the whole, however, the majority of species seem very unwilling to pair when in captivity. The simplest plan seems to be to place them in a roomy box, and leave them to their own devices. A lump of white sugar moistened may be put into the box, by which means the insect may be kept alive some weeks. It is also a good plan to have in the box some of the plant or plants on which the species of larvæ feed. Some very interesting and pleasantly-written remarks on this subject will be found in vol. ix. p. 165, and vol. x. p. 46, of the 'Entomologist's Weekly Intelligencer,' under the signature of "A. B., Brighton." This mode of compulsory pairing with a rare species (unless he have as many as he wants) is, perhaps, not to be recommended, as there can be no doubt that many will come to grief: and perhaps after all he will fail in attaining the desired end, and—"a bird in the hand is worth two in the bush."

THE LARVA.

Rearing.—Supposing eggs to be obtained, from whatever source and by whatever means, we will now consider the best way of rearing the larvæ. When I say the best way, I wish it

to be very clearly understood that I merely mean the way which I have found the best, without at all meaning to insinuate or assert that there may not be a better. This is undoubtedly rather tedious work, and requires much care, patience, and perseverance; but to the true lover of Nature nothing can be more interesting than to watch the gradual development and increase of the little larva—the moulting of the skin; the increased intensity of the colours, or their total change consequent on that moulting; its slow or rapid progress; its manner of eating, &c., &c. Though it is probable that larvæ, when in confinement, do not pursue exactly the same system as when at large, yet in this way we doubtless obtain a tolerably accurate acquaintance with their habits in a state of nature, and thus facilitate our chance of finding them. The most useful cages for very young larvæ are those circular tin boxes, or canisters, which contain, or used to contain, "Cassell's Coffee." Any box, however, of similar size or shape, will answer as well. Take, then, a small bottle (this may be obtained at any chemist's), stout in the body, with a narrow neck (the narrower the better). Fill this bottle with water up to the shoulder, and place in it a sprig of the flower, tree, &c., on which the larva is to feed. Then take some cotton wool, and, rolling it round the stalk, fix it tolerably tight in the neck of the bottle. This is to prevent the larvæ creeping or falling into the water, in which case they come to an untimely end. Next take the bottle and place it in the centre of the canister, surround it about half-way up with fine pulverized or sifted earth, and on this place a layer of moss. This had perhaps better be done before putting in the plant. In addition, when the larvæ are very young, I take a piece of white paper exactly the size of the canister, and, cutting out a small hole in the centre, slip it over the neck of the bottle before putting in the sprig and the cotton wool. N.B.—The object of this is to prevent the little larvæ being lost in the moss. It may be asked, Why put in moss at all? This will be seen hereafter. The sides of the canister, if smooth, should be rubbed round with a little wet earth on the tip of the finger, otherwise, if the larvæ should fall off, they will be unable to crawl up again. Being thus prepared, place your eggs on the sprig. In a canister of the size alluded to above, *viz.*, about four inches diameter, you may safely place a dozen and a half. Then cover the canister with some fine gauze, and the first stage is complete. Supposing the eggs to hatch immediately, you should examine them every morning. This of course can easily be done by simply removing the gauze. I may remark here that a tin lid punctured with fine holes will save much trouble in tying and untying the gauze covering. If the young

larvæ are progressing favourably, minute little pellets of excrement will be seen lying on the white paper. When the food becomes dry or is nearly consumed, place a finger of the left hand on the mouth of the bottle (to prevent its being disturbed), and with the other hand gently pull out the twig. Put in a fresh one, with the cotton wool, as before, rolled round it; and then replace the larvæ. This can readily be done by gently tapping the twig, or just touching them, when in general they will drop off. When larger, the leaf on which they are feeding may be cut off. After the first (or at any rate the second) moult they must be separated. We will follow, for the present, say, six left in the original canister. If they are the larvæ of a moderate-sized Geometra they need not be removed any more. After the second moult the paper may be removed. Then will be seen the advantage of having the moss and mould, for nothing more is required now than to supply the larvæ with fresh food occasionally; and when full fed they will go into the moss or earth, and form their cocoons or spin up, as the case may be. In removing the dry leaves, in addition to a careful search for the larvæ, they (the leaves) must be examined to see if the larvæ have spun up between or upon them. The larvæ of the whole of the pretty genus *Ephyra* spin up in this latter way, fastening themselves like a butterfly, with a thread on the leaf or twig. In the case of the larvæ of larger moths, of whatever Order, after the second moult, distribute them into separate boxes. Nothing is better or simpler for this purpose than the common chip boxes made to hold toys. They are cheap, and can be obtained of various sizes. Cover the bottom of this box (as above) with fine earth about an inch in depth, and on it a layer of moss, which had better be well loosened and torn into shreds. The top of the lid being knocked out, and the frame covered with gauze, all is ready. A bottle is filled with water, &c., exactly as already described. It will be plain, however, that a bottle with the food in it cannot stand upright in such a box. It must therefore be sloped as far as practicable, and supported by something to prevent the water running out. Be careful always to place the cotton wool in the neck of the bottle. In a good large chip box eight or ten ordinary-sized larvæ of Bombyces or Noctuæ may be kept together. In the case, however, of the "giants," as the Sphingidæ and some of the Bombyces, or where there is a large number of larvæ, use what may be called a "larvarium," *viz.*, a very large box, say, three feet square and about the same in depth. Proceed as before with regard to earth, moss, &c. The edges of the top of this box must be smoothly shaved to suit the lid, which is like the frame of a slate, the slate being knocked out. This

is then covered with gauze. In a box of this size small branches may be held in bottles of water, and two or three dozen larvæ safely housed. If placed in a cool room, with plenty of air, they will grow almost as large as if in freedom. It is a most convenient and simple habitation, as nothing is required but to take off the lid, and renew the food when necessary. It is a really pretty sight to see fifteen or sixteen *Notodonta trepida* feeding in such a cage. The number of larvæ to be associated together must obviously be left more or less to the judgment of each individual collector, according to the size of the boxes or cages he employs; but one general rule should not be lost sight of, *viz.*, that the more room they have the better. If there be an exception, it is found in the genus *Eupithecia*. Almost any number may be placed together, without any apparent injury. They are most delightful little creatures to rear, giving no kind of trouble. If in the neighbourhood of the flower on which they feed (the vast majority feed on the flowers and seeds of various plants, not trees), there will be no necessity for the "bottle," as they will go on feeding contentedly as long as a seed, or even almost a husk, remains. I am sorely tempted to make a digression here, and dilate upon the pleasure of rearing Eupitheciæ. However, I will content myself with strongly recommending my readers to try for themselves. In the 'Entomologists' Annual' for 1861 and 1862, and in the 'Zoologist,' will be found elaborate and accurate descriptions, with the food-plant, time of appearance, &c., of no less than thirty-five species, from the pen of the late Rev. H. Harpur Crewe, to whom is due the credit of having brought to its present satisfactory state our knowledge of the earlier stages of this truly interesting genus. Let me add that no one was more ready and willing to impart information. A very good plan for raising larvæ from the egg is to feed them up in wide-mouthed bottles or in small jam-pots, covering them by a flat piece of glass. In order to make this fit closely, the necks of the bottles and the tops of the pots should be rubbed smooth on a stone. Care should also be taken to gather the food when quite dry—as if there be dew or rain, the young larvæ may be drowned in the water which condenses on the sides of the vessel. A small portion of food only should be given at a time.

Alternative Food Plants.—It occasionally may happen that you have larvæ feeding on a plant which grows nowhere in your immediate neighbourhood. It is useful, therefore, to know some alternative food to supply the place of that on which they fed before you possessed them. To give a list of these for each species of larva would take too much space here, but a book on botany would give you the names and descrip-

tions of plants nearly related to the plant on which any special larvæ are feeding, and aid in discovering an alternative food. The common knot-grass is readily eaten by a very large number of larvæ of Noctuæ and Geometræ. Lettuce, also, is eaten by many species in confinement. Grass-feeding larvæ will generally eat almost any kind of grass.

An excellent plan for feeding larvæ when they have grown a little is to obtain from the tinman a circular tin, about 8 in. in diameter and ¾ in. in depth. Through the centre make a hole ½ in. diameter. Then cover the tin with strong unbleached calico, sewing it tightly underneath so that the surface is quite taut (but not covering the hole beneath). Then make a slight cut in the centre of the calico, and, through this and the hole in the tin, thrust from the top an eyelet—such as is used for yacht sails—the required size in diameter. Press this down, and fasten eyelet by hammering at bottom of tin. The calico will now slope down regularly from edge to centre of tin, and form a spring-like surface on which to rest a cylinder as described at page 3. The food can be pushed through the hole in the centre, and the whole tin and glass cylinder stood over a jam-pot with water in it.

Some larvæ will require a stronger covering for the cage than gauze; such are *Dicranura vinula*, *bifida*, *furcula*, *bicuspis* (if you are fortunate enough to find it), *Cymatophora ridens*, *Diloba cæruleocephala*, *Cossus ligniperda*, and some others. These larvæ have powerful jaws, and make short work of gauze. Extraordinary stories are told of the feats of *ligniperda* in this way. One gentleman writes that he put a larva in a cigar-box, and, having placed it on a piano, left it there. During the night it gnawed through the bottom of the box and the top of the piano; and when he went to look for it in the morning, it was gone on a voyage of discovery into the inner regions. Another still more remarkable instance is given in the eighth volume of the 'Zoologist,' p. 2897:—"I placed half-a-dozen caterpillars of the goat-moth in a glass jar, with saw-dust and a piece of willow, and covered the mouth with sheet lead, which was perforated with an awl to admit the air. Three of the caterpillars were to-day crawling on the floor; and, on examining the jar, I found they had effected their escape by gnawing the lead, having enlarged two of the perforations sufficiently to enable them to pass out of their prison. I have replaced the lead with wire gauze, which I expect will puzzle them." Were it not for the unimpeachable authority (the late Professor Henslow) on which this story is given, it could scarcely be credited. From what has been said it will appear that *ligniperda* is a tough customer. For the ordinary wood-boring larvæ, however, a stout square box will

do, with a lid or frame covered with wire gauze. The wire gauze may be bent over the edges of the frame, and fastened down with small tacks. I have a box of this kind, the inside of which is dotted over with the cocoons of the various species of *Dicranura*. Other larvæ, as *Acronycta megacephala*, *A. tridens*, *A. psi*, *Diloba cæruleocephala*, &c., are very fond of spinning up in these empty cocoons. Virgin cork, in which numerous holes have been bored by means of a gimlet, may be placed in the cages, as many larvæ—especially certain of the *Acronycta*—will pupate in these holes. If such cork is not available, stems of bramble, elder, or others in which there is plenty of pith, may be used, also dead, hollow stems of other plants. It will be observed that, in the case of the larger larvæ, the excrement rapidly becomes mouldy. This may now and then be removed.

Sleeving.—If living in a place where the larvæ may be safely sleeved,—that is, covering the growing branch of the food plant with a muslin or calico bag shaped like a sleeve, and placing the larvæ inside,—there will be a better chance of keeping the larvæ during the winter. Indeed, some species, such as the *Drepanulæ* and the genus *Ennomos*, for instance, may be reared in these bags from the egg to the pupa state almost without trouble. The eggs should be secured to the branch (by tying or pinning), one end of the sleeve tied round the branch, and the other gathered up and tied over the end of it. Care should be taken to tie these ends sufficiently tight to keep out ants, earwigs, &c. In thus rearing those larvæ which require earth in which to turn to pupæ, a large flower-pot containing earth may be brought to the tree, and the end of the sleeve which has been gathered and tied up may be passed over and securely fastened to the rim of the flower-pot; the larvæ will then be able to descend into it and bury themselves.

Collecting Larvæ.—This head opens out a wide and extensive field of operations. There is scarcely a tree, shrub, plant, or flower, which has not its caterpillar or caterpillars. Even the holly, laurel, and deadly nightshade are a pabulum; nor is it the ass alone that eats thistles. The following are among the best methods of finding them:—beating, sweeping, searching, and night-work.

Beating.—The operation is simple, but laborious. The implements required are—an umbrella, a stout walking-stick with a hooked handle, and a strong arm. An umbrella of the "Gamp" material and dimensions is the best. If it be a tree

which is to be thrashed, open the umbrella and place it on the ground. Then grasp the branch with the left hand, and apply the stick vigorously to its back. Examine carefully the contents, which will be found to consist of an *olla podrida* of dead leaves, earwigs, spiders, larvæ of sawflies, Cimicidæ, &c. Should you, on this first examination, see anything you want, take it of course. If not, turn the umbrella gently from side to side, so as to turn the rubbish over, and larvæ may often then be detected, after which turn out the rubbish, and then look again carefully. The contents should not be turned out roughly, or too soon. The shock is serious to delicate and contemplative larvæ, and they require some time to recover their legs. If, therefore, the contents are turned out too soon, they will drop out and be lost. Very small larvæ may be taken up by moistening the tip of the middle finger, or by means of a feather or camel-hair brush. Larger ones will drop into the box by placing its edge near them and tilting them in. In all cases care should be taken to handle them as little and as gently as possible. The only objection to beating is the number of curious insects that manage to get down your back. It is also well, when engaged in this operation, and the face upturned, to keep both eyes and mouth shut, lest a fat earwig or an odoriferous *Cimex* should drop into one or the other. If it be a shrub, collect a number of twigs in the left hand, and proceed as before. If it be a flower, either beat it with the stick into the umbrella, or, with the flower in one hand, beat it against the ribs; or gather a handful and do the same. The hook to the stick is useful for laying hold of and shaking a branch. By jarring the branch suddenly, the larvæ are dislodged, while but few leaves will fall and the trees and bushes will not be disfigured. Disregarding this plan gives just cause of complaint to owners of woods, &c., and often leads to withdrawal of leave to collect and other unpleasantness.

The **Bignell Tray** is employed by some collectors, and is thus described by Mr. Bignell in the 'Entomologist' for April, 1875, No. 141:—

"Fig. 1, opened ready for use: fig. 2, reverse side; fig. 3, partly opened, *4* is to be brought over to *5* and fixed under the notch in handle; to close it, *4* is brought to *5* in direction of arrow. Figs. 4 and 5, ribs. Size of tray 4 ft. 6 in. long, 3 ft. wide, covered with black calico. The rib, 35½ in. long, made in two parts—ash 22 ins., cane 13½ in.; the object in having part of wood is to keep that portion stiff; the cane makes the necessary curve to form the tray. The cane is fastened to the wood by a brass hinge, over which is passed a taper ferule;

the other end of the wood is covered by a small ferule about 1 in. long with a hole through it, *8* (figs. 4 and 5): a hole in the handle in the same way. A stout piece of wire is passed through the whole and riveted up tight; the calico is fastened

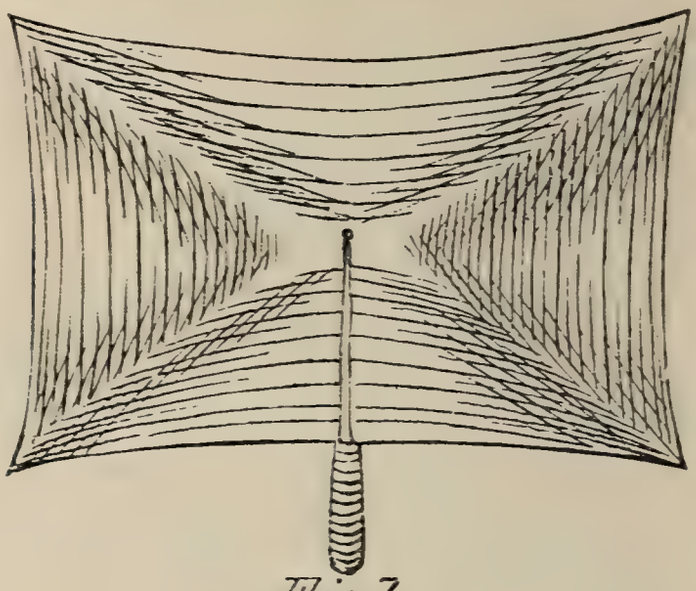

Fig 1.

to the framework at *8*, *9*, *10*, *11* (fig. 5). *11* is a piece of tape sewn on, about 5 ins. long, to receive the point of the cane, and a false hem is made to receive the handle at *4*, *5* (fig. 3). The handle, 25 ins. for the longest and 20 ins. for the shortest, *4* (fig. 3)."

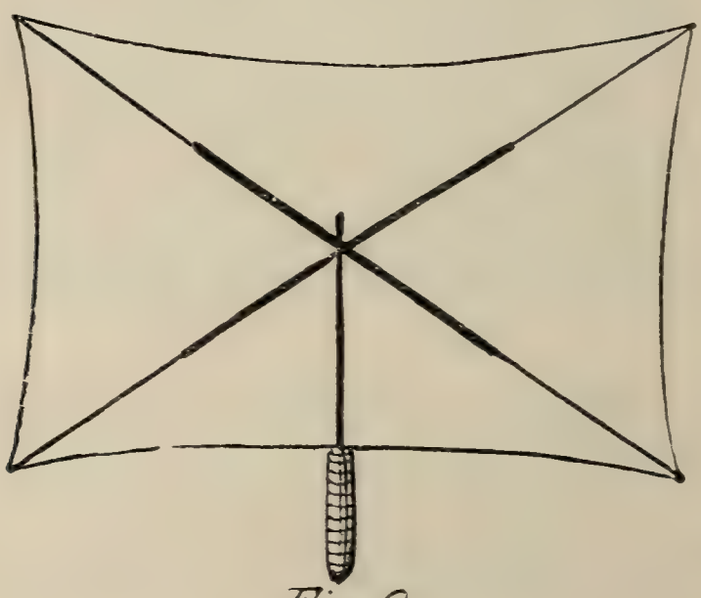

Fig 2.

The best time for beating is after dark; the larvæ, having left their hiding-places, are then feeding.

Sweeping is the method employed to obtain larvæ which feed on low-growing plants and flowers, and which, in conse-

quence, cannot well be beaten into an umbrella. A very good implement for this purpose is a common bag-net. The net must be made of strong calico or holland, or, better still, of "cheese-cloth," about a foot and a half in depth, and must be

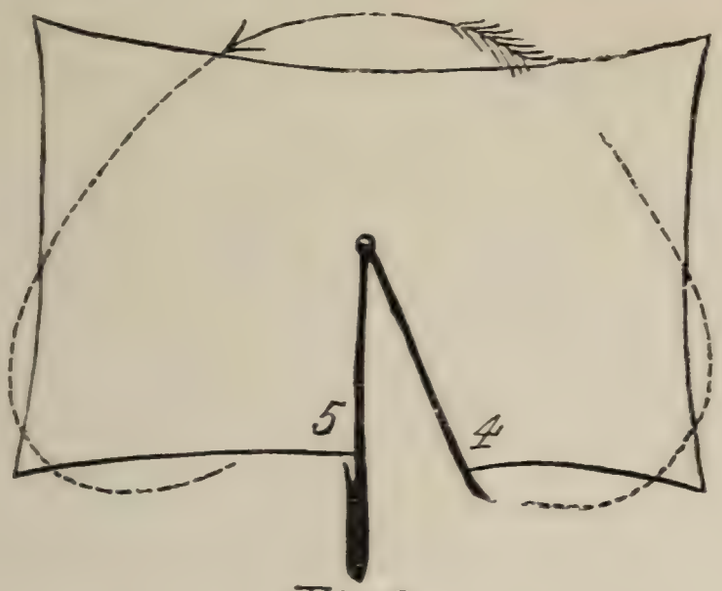

Fig 3.

sewn on to an iron hoop about the thickness of a goose-quill. The circumference of the hoop should not, I think, be less than thirty inches. The hoop must then be fastened to a short handle. The lighter the instrument, consistent with stability, the better. With it you sweep from side to side among the herbage, flowers, heather, &c., stopping occasionally to examine

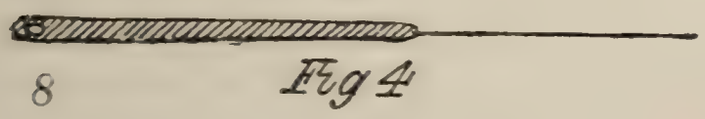

Fig 4

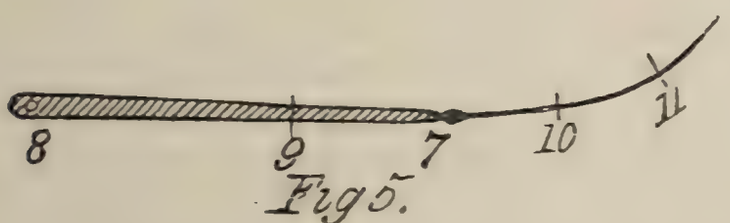

Fig 5.

the contents. The dusk of evening is the best time for sweeping, and the contents of the sweeping-net may be turned into tin boxes, so as to examine at leisure when at home.

Searching.—That is, searching for larvæ with no other instruments than the eye and the hand. It is astonishing how expert the collector may become in this respect by a little

practice. The most successful larva hunter in this way, with whom I became acquainted, was the late Rev. H. Harpur Crewe; and whatever little skill I may have myself is mainly due to him, and I gladly take this opportunity of saying so. In "searching" for larvæ, shrubs and saplings are better than trees. Take hold of the twigs or small branches, and turn them up as already described in looking for eggs, and look carefully down the midrib of the leaves, where, or on the stalk, the larvæ of Geometræ will generally be found, laid flat or rigidly extended. The larvæ of the Bombyces and Noctuæ, on the contrary, will usually be found exercising their masticatory powers, or undergoing the process of digestion, on the edge of the leaf. None but those who have actually experienced it can realize the delicious sensation of seeing a noble *trepida*, or *ocellatus*, or *ligustri*, proudly throwing back its head as if indignant at being disturbed, or shaking it to and fro as if in mute remonstrance, and appealing to be left alone—an appeal which, so far I as am concerned, I can confidently say has never been responded to. I am reminded here of an anecdote which I read some years ago in 'Kirby and Spence,' of a gardener who "was quite disconcerted by the self-sufficient air of these larvæ, remarking that he had never seen any other caterpillars hold their heads so high." Larvæ may also be obtained by simply *shaking* a branch. If this be not done too strongly, the larvæ, being disturbed, will drop off, at the same time suspending themselves by a thread, when they will easily be seen. Many larvæ, such as the genera *Clostera*, *Tethea*, and others, when hatched, immediately spin two leaves together, and feed between them. As they grow they continue so to feed. They do not seem to feed much during the day; but towards evening they creep out and, having demolished the adjoining leaves, return in the morning to their nest, if it may be called such. It is to be observed also that they change their skin between the leaves. Now it is almost, not to say entirely, useless to try and find these larvæ by beating. If you are searching *shrubs*, you will soon see if two leaves are spun together. You can, in this case, either partially open them to see if there be any caterpillar, or simply cut off the two leaves with a pair of scissors (which, with a sheath, should always be carried in the waistcoat pocket), and examine them at home. In this way, larvæ of *T. populeti* may commonly be found on aspen. In the case of *trees* I have found it an excellent plan to look up at the leaves against the sky, when the larvæ, if there, may be seen coiled up between them. A long stick with a hook is a necessary implement to draw down the branch when beyond reach. In this manner plenty of the larvæ of *T. subtusa* may be taken, and in almost any part of the

country. It is generally considered an uncommon insect, but I believe it is so only from the fact that many collectors are ignorant of the right way to search for the caterpillar. Again, should you observe the *edges* (for as a rule the larvæ of moths do not attack the centre) of the leaves of any shrub, flower, or plant, notched, you must carefully examine it. Pellets of excrement, whether lying on the ground or on the leaves, are as a rule a certain sign of the neighbourhood of larvæ. It is a good plan to get under a shrub or small tree, and look *up* at the leaves, on the under side of which caterpillars will frequently be seen lying at full length. Great care should be taken in boxing them, as, though some adhere firmly to the twig or stalk, others drop off at the slightest touch or shock. Larvæ may also be found by turning up the dead leaves of many plants, as primrose, dock, plantain, mullein, &c., &c., hybernating under moss on trunks of trees, behind loose bark, under stones, in stems of various reeds and grasses, in fact, anywhere. Many larvæ of Fen Lepidoptera may be found feeding either in, or on, the reeds—*Arundo phragmitis*. The larvæ of *L. straminea* feed on the leaves, and may be often found at night. The larvæ of *L. phragmitidis* feed in the upper part of the stem, but emerge to pupate under ground. The larvæ of *N. neurica* also feed in the upper part of the stem and pupate there; while the pupæ of *N. geminipuncta* (the larvæ of which also feed in the stems) may be found just above the water. Larvæ of *N. lutosa* feed in the roots far under water. These internal feeders may readily be detected by the withered appearance of the topmost leaves of the reeds and by the small holes which they make just above the internodes of the reeds. Good lengths of the fresh reeds should be provided for the larvæ, and the food is best kept by sticking the stems into wet sand. In the stems of *Typha latifolia* and of *T. angustifolia* larvæ of *N. typhæ* and of *N. cannæ* may be found.

To find Larvæ by Night.—Little requires to be said under this head. A very large proportion, probably a considerable majority, of the larvæ of Noctuæ feed only by night, concealing themselves during the day in various out-of-the-way places. They may, as has already been observed, be occasionally found under stones, &c.; but the easiest method is simply to take a lantern (the electric torch flash-lights are very useful) as soon as it is dusk, and search banks, hedges, hedgerows, shrubs, flowers, reed-beds—anything, in short, which presents a reasonable prospect of success. Much, very much, remains to be done in this way by the practical collector, for although, owing to the exertions of Messrs. Newman, Hellins, Buckler, &c.,

our knowledge of the larval state has vastly increased, yet many larvæ of the Noctuæ are as yet unknown in this country. The larva hunter must be supplied with a number of pill-boxes. Tin boxes (size optional) with perforated lids are also very useful. One, two, or more larvæ may be placed in the same box (according to size), provided always they are taken off the same plant or tree. The fewer that are placed together in a box the better, as they become restless and are apt to injure each other. A box to himself should always be given to a rare caterpillar. Some of the food should of course be placed in each box. Some larvæ are carnivorous, and, if known to be so, must obviously be kept separate. Two, *Scopelosoma satellitia* and *Cosmia trapezina*, are especially so. The latter of these is a truly bloodthirsty creature, and will almost allow itself to be torn asunder rather than leave a caterpillar it has once laid hold of. I am informed that the larva of *D. livornica* is also a cannibal: neglect to give ample fresh food tends to create cannibalism.

Hybernating Larvæ.—With regard to these I am afraid I cannot give many directions. It is troublesome work. Some require no food, as *Iodis vernaria* which feeds on *Clematis; Angerona prunaria* on various plants; *Arctia fuliginosa* on ragwort, &c., and other species. In this case leave them to themselves, in a cage full of moss and the dried plants on which they have fed. Many hybernating larvæ, especially among the Noctuæ, must be fed throughout the winter. Experience leads me to believe that the majority of those which hybernate feed on low-growing plants, and not on trees. However this may be, some even of those which feed on trees will, when in captivity, take to low-growing plants during the winter. The most acceptable of all plants seems to be *Polygonum aviculare*,—while it can be obtained,—and dandelion, plantain, and violet are also favourite foods. The plan to adopt is very simple—merely a moderately-sized box covered with gauze. In it are placed sods of the food-plant. These must of course be occasionally renewed, great care being taken that the little larvæ are not thrown away with the old sod. The finding the larvæ is perhaps the most troublesome part of the business. Descriptions of various kinds of elaborate apparatus for keeping larvæ through the winter have been given; the boxes to have the bottoms perforated with holes; then a layer of gravel, &c., &c. But nothing more is required than a box prepared as above. There is not the slightest necessity for putting the box out of doors. It is perhaps as well to put it near an open window, though this is not by any means indispensable. An airy room is sufficient. I have succeeded in rearing in this

way *Arctia fuliginosa*, *Epunda lichenea*, *Iodis vernaria*, &c. *Bombyx rubi* may be bred by placing the larvæ in a compartment like, and about the size of, the frame such as is used to grow melons, &c., but with Willesden scrim instead of glass on the top, and planted with plantain, dandelion, and other low plants, and having round it, inside the frame, a quantity of cut heather. The larvæ will hybernate in this latter. A sharp look-out for ants and other noxious things must be kept. When, in the early spring, the larvæ begin to feed rapidly and grow large, they must of course be separated, as already directed. If the collector be living in the neighbourhood where the insect occurs, it is perhaps an unnecessary trouble to keep them through the winter, as the larvæ may be found at large in the spring months, by some of the methods already adverted to. Whatever care and pains be taken, it is obvious that Nature must be the best nurse and care-taker. Sleeving (as before described), where practicable, offers, perhaps, a better chance of keeping certain larvæ through the winter.

A large number of larvæ feeding on the same plant may easily be reared by obtaining a large tub, placing in the bottom of it about a foot of earth previously baked. Then drive in the sides, obliquely downwards at about eight inches from the top, and at equal distances on the inside, three or four stout nails, leaving about half an inch projecting. Then fill a large-mouthed bottle—a pickle-bottle will do—nearly to the top with water—having tied a string tightly round the neck, leaving a loop by which to hang the bottle from one of the nails; then fill the opening with the food-plant (stopping the interstices with cotton-wool), and hang it on one of the nails, spreading the plant so that it covers as much as possible the opening of the tub. Place the larvæ on the food, and cover the whole of the top of the tub with muslin. When fresh food is required, all that is necessary is to hang another bottle of food on another nail, so that the fresh food shall be freely in contact with the remains of the old food, and the larvæ will crawl from one bottle to the other. When fresh food is again required, insert another bottle on another nail, and in all probability the first bottle can then be removed without any manipulation of the larvæ. In this way I have bred many hundreds, especially Noctuæ, with but little trouble. The larvæ descend to pupate in the soil at the bottom of the tub, and when all have done so, the pellets of frass which have accumulated may be removed and, if thought necessary, the pupæ may be taken out.

Removing the Pupæ.—I am in the habit now of removing the pupæ about a fortnight or three weeks after the larvæ have gone down or spun up. I do not assert this to be the best

plan; but whether it be so or not there can be no manner of question but that they should be looked at every now and then. The period which elapses before the larva turns to a pupa varies with different species. As a rule ten days will be found sufficient for those which pass the winter in that state. Of those species which make their cocoons in spring, and of which the perfect insect appears in the autumn, the great majority remain a long time in the larva state before turning. These must of course be left alone at any cost. The following may be mentioned as coming, from my own knowledge, under this category, viz., *Hadena proteus*, *Miselia oxyacanthæ*, *Epunda lichenea*, *Cirrhœdia xerampelina*, *Xanthia citrago*, *X. silago*, *X. cerago*, *X. aurago*, and others. As bearing on the subject of looking occasionally at your pupæ, the following is an extract from the 'Intelligencer,' vol. vi. p. 14: "Slugs and Worms.—I have just made a memorandum to bake all the earth and moss intended for breeding-cages, and so to exterminate the slugs and woodlice, which, small when first introduced into the breeding-cages, grow large and fat through the winter by feeding on the pupæ. I have known a slug crawl in a straight course more than a foot up the side of my cage to get at a chrysalis, and then feast on it till there was nothing left but the empty skin. They will also devour whole broods of young larvæ." The above danger may be obviated, so far as the earth is concerned, by passing it through a fine sieve, as already directed. Upon the moss pour boiling water, which is an effective exterminator. It should be borne in mind that many larvæ become cannibals when in confinement, especially if there be any insufficiency of proper food. The larvæ of the genus *Tæniocampa* may be mentioned as speedily acquiring this propensity. *Stauropus fagi* and many others should be carefully watched. Even the larvæ of *Thecla w-album* will sometimes eat the newly-develo-loped or soft pupæ of its own species.

Describing Larvæ.—If it be required to describe a larva, separate it, and, having made the best description one can, put it (the description) in the box where the larva is feeding, and afterwards with the pupa. Here I wish to urge upon the young collector the practice of taking these descriptions. I do not disguise that it is both troublesome and difficult. But by doing so we not only advance our knowledge, but we have the pleasure of imparting that knowledge to others. I have been enabled to add many insects to my collection by reading the descriptions of larvæ, their food, habitat, &c , which from time to time have been published. It is the selfish practice of some to keep their knowledge to themselves, especially in the case of rare species (which, so long as they continue so, are invaluable

in filling up gaps); but let my young readers eschew such proceedings. In describing a larva the late Mr. Newman requested his correspondents to "call the six thoracic legs, not prolegs, but simply 'legs,' and the abdominal appendages 'claspers.'" It must also be remembered that when referring to the "segment" the "head" is the first. If there be a larva to spare, it should under all circumstances be preserved—as a skilfully-preserved larva conveys at a glance more than a page of description. The method of preparing larvæ is given at p. 19.

Parasites of Larvæ.—In rearing, the young collector must be prepared for frequent disappointments. A considerable proportion of the larvæ taken at large will be found to have been stung by ichneumons. Larvæ which have been thus stung, as a rule, take longer to feed up than those which are healthy. Hence, if we find the larva of a species abnormally late, we may be pretty sure it has parasites to support. According to my experience the genera *Notodonta*, *Dicranura*, and *Eupithecia* are most subject to the attacks of these odious pests. Three or four dozen emerge from the body of one single unhappy *Eupithecia*. It is indeed difficult to understand how the unfortunate caterpillar can continue to exist with such a host gnawing at its vitals. It is sometimes a painful, at others a disgusting, and at all times a disappointing, spectacle to see the internal feeder make its exit through the skin. In the case of *Ephyra pendularia*, for example, the larva, when full grown, instead of turning into a pupa, assumes a sickly appearance; the colours fade, and the larva, attaching itself by the claspers to a twig or to the gauze, stretches out at full length. This lasts for a day or two, when the anal extremity of the body may be seen to swell or bulge out, and, speedily splitting, the perfectly formed cocoon of the ichneumon is seen. Nothing is left of the original caterpillar but the shrivelled skin. In other cases the (apparently) apodous grubs, three or four in number, will eat their way out, and, clinging round it, will form their cocoons on what remains of the poor larva. In many instances, however, especially among the Bombyces and Noctuæ, they manage to become pupæ, and the mischief is not known till, in the place of the anxiously expected moth, a ferocious ichneumon makes its unwelcome appearance. This is done by sawing a circular hole through the capital extremity of the pupa. The rasping sound produced by the jaws of the enclosed ichneumon during this operation may be plainly heard, and may be termed the death-knell to the collector's hopes. It frequently happens, however, that the presence of an ichneumon in the pupa may be detected long before the insect emerges, for the shell will after a while

burst, and disclose another pupa, *viz.*, that of the enemy. Again, when the perfect insect of a butterfly or moth is about to emerge, it is well known that the posterior segments of the pupa become elongated, through the efforts of the imprisoned insect to escape. Should this occur in a chrysalis which is to pass the winter in that state, within some days, or even weeks, after its turning, you may be certain an ichneumon is there. If opened at once, the larva will be found; if a little later, the soft imago. But to return to the young collector's disappointments. From what has been just said, it will be plain that larvæ hatched from the egg offer much the best chance of successful rearing; but even these may be attacked through the gauze by parasites when sleeved out of doors. If the sleeves have light hoops made of split cane sewn inside, the parasites have not such opportunities of getting at the larvæ on the branches. But numerous perils, even in this case, have to be encountered and surmounted between the cracking of the egg-shell and assuming that of the pupa. Some of the brood, especially when very young, will die in moulting their skin; others from various diseases to which caterpillar flesh is heir. Though, to use correct medical phraseology, the prognosis and diagnosis of many of these diseases are known, unhappily a proper course of treatment yet remains to be discovered. Such diseases are—cholerine, muscadine, the growth of fungi or vegetable parasites on the bodies of the larvæ, &c. These originate from over-crowding, want of sufficient air, or damp. The most irritating thing is to see the larvæ die off when they are full-fed or nearly so, without any apparent cause or reason. I will instance two cases that have occurred to myself, so that beginners may see that the "old hands" are often disappointed as well as the young ones. A friend had sent me a number of eggs of *Epunda lichenea*. As the larvæ were to hybernate, I prepared a box for them, and supplied them with groundsel and chickweed. With some little trouble I carried them through the winter. In February and March they fed-up rapidly and well, and towards the end of April I had about fifty fine full-grown, healthy-looking larvæ. I was daily expecting them to go down, when from some, to me at least, mysterious and unknown cause, they began to die off one by one until only twelve remained: these became pupæ. The other case was that of the eggs of a *Eupithecia* sent me by Mr. Crewe. These hatched in due time, to the number of about forty as well as I can remember. They fed up to the end of September. During that period, however, first one and then another dropped off, and on the 26th of that month the last died. This is of course discouraging, not to say disheartening; but the entomologist will act wisely in adopting two of Jacob Faithful's mottoes—

"No use in crying," and "Better luck next time." I think I have now said all that is likely to be of service, or to interest, on the subjects of finding and rearing larvæ. It only remains for me to add under this head that I hope the foregoing instructions may be of use to the beginner. As he advances he will find that "Necessity is the mother of invention," and will doubtless strike out new, and very possibly better methods for himself.

Parasites, however, are not "an unmixed evil," as they form interesting additions to the collection, being so intimately connected with the life-histories of the Lepidoptera. At any rate, they may be sent to those gentlemen who make a study of them. Rearers of Lepidoptera, by this means, have materially aided the study of other branches of Entomology.

Preserving Larvæ.—At the Entomological Exhibition, held at Westminster Aquarium in 1878, there was a splendid collection of preserved larvæ, exhibited and preserved by Lord Walsingham. The following is the plan which was adopted and obligingly communicated by his lordship:—

"Let the larva be taken at a time about two days after it has changed its skin (this is not necessary, but it ensures the colours being at their best, and less liable to fade in the operation). Kill by immersion in spirits of wine. Roll out the interior on blotting-paper with a smooth wooden pointed roller, which answers for larvæ of different sizes, taking care to keep the surface of the skin dry.

"Begin rolling first near the anal aperture to get the entrail well started, and then begin again near the head and work gradually downwards, not pressing too hard, or you may remove the pigment from the inner surface of the skin.

"Now you require the following apparatus:—

"1, a spirit-lamp. 2, an iron tripod some five or six inches

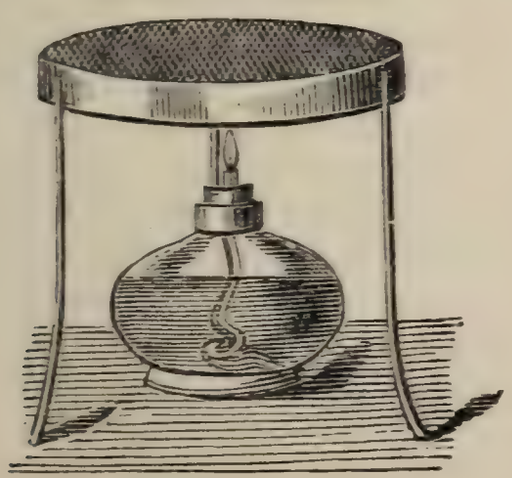

Fig. 6.

in height, having a circular wire-gauze-covered top. 3, small glass blowpipes, which can be made by drawing out a glass tube over a spirit-lamp. Sizes in proportion to the larvæ. There should be a bulge (not shown in the figure) at the end of the tubes, to assist in holding the skin on as it dries; it must, however, be very slight or the skin will not come off again. A piece of watch-spring is heated at one end and twisted round the glass tube; the other end, which retains its spring and curve,

Fig. 7.

presses on to the side of the tube, and, having a V-shaped mark in the extreme end, holds the skin while drying. 4, an india-rubber ball and tube, as used for spraying throats.

Fig. 8.

5, a fine pair of steel forceps, curved at the ends. 6, a setting-needle in wooden handle. Now insert a blowpipe of right size into the skin of the larva so as to include the bulge; slide the watch-spring clip so that the extruded entrail is held by it. Fix the blowpipe into the end of the india-rubber tube (*a*); light the spirit-lamp under the tripod, and, holding the blowpipe with the skin of the larva over the gauze-guarded flame, inflate gently and gradually. Dry the skin, first at the anal end (which will adhere to the glass tube), and then thoroughly all over until it is quite stiff and will retain its form in the required position. The skins may be manipulated by putting the blowing-ball (*b*) in the mouth, and so have both hands free. When dry, push off the larva from the tube very carefully, so as not to break the anal feet, and mount it in any way desired with collefort à froid,—French cold glue,—probably shellac.

"A little dry colour poured into the skin and shaken about will replace to a certain extent the green tints, if necessary (green nearly always flies over the heat). The colour may

be inserted with a small 'spoon' made of a stem of dry grass split lengthwise and cut to size."

As the cost of this inflating apparatus may deter some readers from attempting to preserve larvæ, the following figures and description are taken from vol. x. of the 'Entomologist,' p. 227 and following pages. The description of this "pressure bottle" occurs in an article "On the Preservation

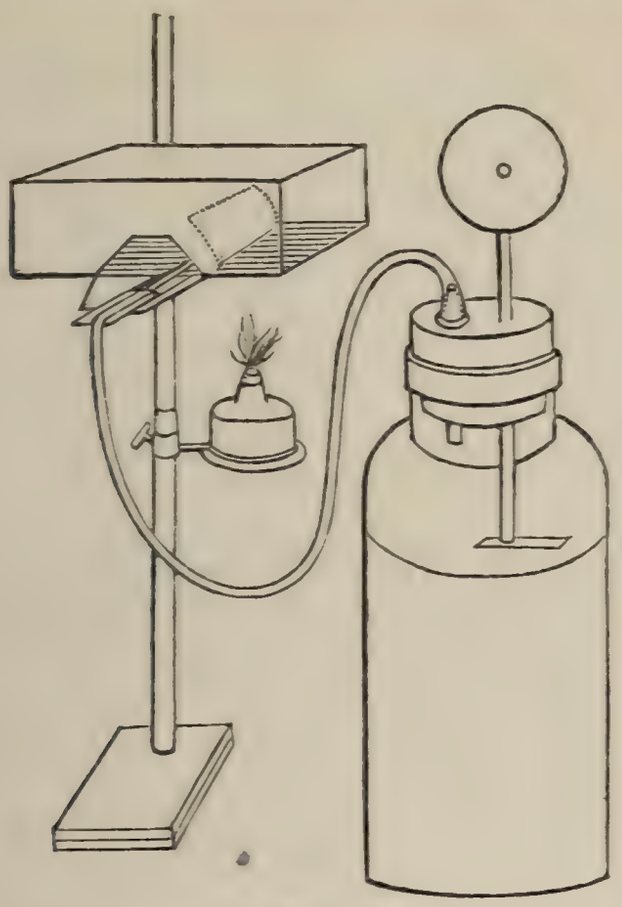

Fig. 9.

of Lepidopterous Larvæ by Inflation," by C. H. and H. M. Golding-Bird:—

"Obtain a strong bottle of not less than twenty ounces (one pint) capacity, about an inch and a half across the mouth: these can be bought at any chemist's; certain drugs are sent out in them from the wholesale houses. Get an india-rubber cork, exactly fitting and bored with two holes; into one of these holes a piece of glass-tubing three inches long is inserted (this is the 'delivery tube'), and into the other a similar piece of glass tube, only double the length, so that it may project freely into the cavity of the bottle, and rise free of the first tube above the cork outside. The end in the bottle is filed or ground flat, and then, with sealing-wax, fastened on to a small plate of metal (tin or zinc) of the exact size and shape shown in figure 10. This piece of zinc is bored with a hole one-eighth of an inch in diameter, at a quarter of an inch from one end (as shown in the woodcut); the edges of

the hole must then be smoothed down perfectly by rubbing the metal up and down a hone or piece of slate a few times. It is exactly over this hole the glass tube is fastened, so that there will be a free passage for the air, through both, the junction of the tube and metal being rendered air-tight by the sealing-wax. Now fasten by its narrow end (in the position shown by the dotted line in the woodcut) a slip of thin gutta-

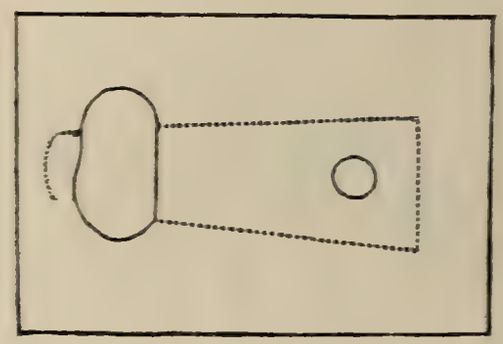

Fig. 10.

percha tissue, or, still better, of oil-silk, by means of any cement, so that the broad end shall freely play over the hole; a valve opening inwards is thus made. To test the valve, suck at the free end of the tube, and if no air passes, the valve is good; if any can be sucked through, it is useless, and a new one must be made. The causes of failure would be either using too stiff a piece of gutta-percha or oil-silk, or pieces that have fine holes in them, or else the valve-hole in the metal has not its edges smoothly ground down. By attending to these details anyone can soon construct a valve. The reason for using the india-rubber cork is that an ordinary cork (unless *very* sound) is not air-tight to the pressure of air employed, while if rendered impervious by the use of sealing-wax it could not be removed to clean or renew the valve. These corks, already bored, may be had at any chemical apparatus manufacturers, and are most convenient, as they can be removed at pleasure. If the cork be now placed in the bottle with its tubes fitted in, and if the delivery tube be stopped up and air be forced in by the mouth through the valve, it will remain in the bottle if the valve be sound, rushing out with a small explosion only on opening the delivery tube. Strong though the puff of air thus given seems, it is quite insufficient for the purpose in hand, and a far greater degree of pressure than can be obtained from the operator's lungs is requisite. To obtain this, get a child's india-rubber ball, not under two inches in diameter; if it has a hole already in it bore another at one side with a hot wire, of rather more than the size of a crow-quill; should there be no

hole at all, two must be made, one at the pole of the ball, the other at its equator. These balls usually contain a good deal of sulphur in powder. After making the holes, squeeze out all this powder, as far as you possibly can, or else the valve will be rendered useless by the powder falling on it. It is a good plan to push a little cotton-wool into the upper part of the glass tube bearing the valve; it filters the air as it passes down. Now push the ball by one of its holes on to the glass tube that bears the valve, and if not fitting accurately to the tube, a little cobbler's wax will make it do so. If now the ball be pinched between the thumb and finger, the thumb being placed over the second hole, the air in the ball is bound to enter the bottle, while on removing the hand the ball again expands, air entering it by the hole that was just before closed by the thumb. The air in the bottle cannot be sucked out again by the ball, because of the valve; and so, by repeating the process, the bottle can be charged even to bursting, unless of good glass. Complicated though this description of the apparatus has been, it can all be made in less time than the account has taken to write; while the advantages it offers over air-pressure from the lungs are incalculable. To some persons, inflation of many larvæ in one day by the chest might be a serious evil; while to all it must be a very wearying, uncomfortable process; and since the air must of necessity be injected in an intermittent manner, the larva would be longer drying. With the exception of two or three feet of india-rubber tubing, every entomologist would have the remaining needful materials by him, such as pins, cork, forceps, &c."

The following mode of procedure is described by Mr. H. A. Auld, at page 78 of volume ix. of the 'Entomologist':—

"Although the mode of preserving larvæ for the cabinet is familiar to many practical entomologists, there may be a few who read this Journal to whom the method, simple as it is, may be unknown. Specimens are often seen pickled in bottles of spirits; but treated thus they seldom form very beautiful objects, and, enclosed in tubes and vials, cannot be arranged side by side with the imago forms. Therefore, to know how to preserve larvæ in such a way that they may be placed with the perfect insects, and so enhance the interest of their collections, would doubtless be a boon to many a tyro-lepidopterist; and in the hope that, now the season has fairly set in, some may be induced to experiment upon the commoner species, these few notes are offered. A blowpipe is required; but as the instrument, constructed as it generally is, would be unfit for the work, it is necessary to procure some specially made from glass-tubing, the end of which is to be melted and drawn

out to a fine point. It is, perhaps, preferable to make them oneself from tubes of various diameters, so that the largest or most minute larvæ may be operated upon. Two pieces of watch-spring, about three inches long, each having a portion at the tip heated, and then bent at right angles, a quarter of an inch from the end, should be bound round the blow-pipe. A spirit-lamp, tripod stand, and an oven, are also requisite, the latter being easily made from a tin-canister, such as chocolate is generally sold in, by punching out of the lid a hole the size of a florin. It is almost superfluous to mention that the larvæ should be in good condition, and selected, if possible, shortly after their skins are cast, but not before they have regained their toughness. They should be killed in the cyanide bottle, or with anything not destructive to their colour, and than steeped for an hour or so in a solution of alum to harden the skin. The internal organs are then to be removed by forcing them through the anal aperture with the fore-finger and thumb between blotting-paper. The inside being completely removed in this way, the larva should be fastened to the blowpipe in such a manner that the two pieces of watch-spring pressing against the point of the tube may grasp the smallest portion of its last segment. Thus fastened, it can be gently inflated and kept distended whilst drying in the oven, which, in the case of small specimens, will occupy from one and a half to two minutes, according to the heat, which should not be raised very high for those of a delicate colour. It sometimes happens that when inflated the larva does not assume the position required; it bends into a semicircular form, or the head-part curves downwards. To remedy this a simple arrangement of thin wire tied to the blowpipe may be made to hold it whilst drying; in fact, by bending the wire it may be held in any position. When removed from the oven dry, the specimens are ready to be mounted on twigs, very fine ones being cut to fit in between their claspers. If mounted in this way on the food-plant, they will possess a very life-like appearance, and form beautiful objects for the collection. *Cossus ligniperda* preserves admirably; and the Bombyces will be the favourites of all who take to preserving. The larvæ of the Sphingidæ, if of a green colour, are almost sure to fade during the drying process, which for them should be conducted very slowly. Some persons restore the natural colour by the use of pigments; but this is to be deprecated. If there are many which do not retain their natural appearance, there are, on the other hand, many that do; and by practising on these a proficiency may be acquired which will enable the operator to manipulate the others with better chance of success."

THE PUPA.

Pupa Digging.—Some years since a few remarks of mine on this subject were read before the Entomological Society. I imagined the matter to have excited little or no interest, until I read, with, I trust, pardonable gratification, the following passage in an article addressed to the 'Intelligencer,' p. 74:—"Most of your readers will recollect a paper on digging for pupæ, which gave such an impetus to that mode of collecting." On reading this paragraph I forthwith determined that I would, if spared, write a few additional observations for the pages of the 'Zoologist,' in the hope that its readers might thereby be persuaded, in however slight a degree, to apply themselves with zeal to this method, by which their favourite study can be pursued during the long and dreary months of winter and early spring. I am the more induced to take this step, from the fact that I not unfrequently receive communications from my entomological friends and correspondents, making grievous complaints of their want of success; some asking information as to the "modus operandi"; *all* inquiring, "What is the cause of my want of success?" In reference to the first of these questions, some remarks will be found at the close of this paper; in regard to the second, "What is the cause of my failure?" I answer, "Many causes doubtless combine to produce this undesirable result; such as a want of experience, a sticky and clayey soil, unfavourable (*i. e.*, wet) weather, &c." But I have no hesitation in expressing my firm conviction that, in nine cases out of ten, want of *success* proceeds from want of *patience*. A meets B. "Have you heard," inquires A, "of C's wonderful success in pupa digging? He has taken *dodonæa*, *chaonia*, *fagi*, *ocularis*, and I don't know how many rare insects." "You don't say so," excitedly replies B; "how is it done?" "Oh," replies A, "simply enough: take a common garden-trowel and a box lined with moss; dig at the roots of any good-sized tree, or tear off the moss, and the pupæ will tumble into your box *ad libitum*." Enthusiastic B rushes home, seizes a trowel, procures a box large enough to hold all the pupæ for miles round, and departs, buoyant with hope, upon his first pupa-digging excursion. "Let me see," he soliloquises, "what shall I do with my *surplus* pupæ? Ah! Mr. L. wants *trepida*; well, he shall have two; and, if I remember rightly, Mr. S., who sent me so many insects I did not possess, said he wanted *ridens*; therefore he shall have three." While thus meditating, a majestic oak strikes his eye. "Lo!" he exclaims, "the very tree for both species!"

Nervously, yet firmly, he grasps the trowel, and approaches the unconscious tree. Forthwith the trowel is inserted half a foot into the earth, and, by a prodigious muscular effort, a gigantic sod is turned up. Eagerly he gloats over and peers into the sod lying before him: nothing meets his eye but a writhing worm and a wriggling centipede. "Why, how is this? here's *nothing!*" With crushed hopes he is about to leave, when suddenly he remembers that he was directed to tap it gently, and then tear the roots asunder. The sod is tapped—an earwig! The sod is discerpted—a woodlouse! Perspiring with his exertions, with aching back he rises from his knees, looking rather foolish. (N.B.—The digger's feelings, at this crisis, are often additionally lacerated by a small mob of boys, looking on with gaping mouths.) He rises, I repeat, from his knees, takes up his huge box, and goes to a poplar: the same process—the same result. Then to a birch: ditto, ditto. This is too much! Angry and disappointed, he hastens home, seizes a sheet of paper, and writes off to the author of "that paper" on pupa digging to ask, "What is the cause of my want of success?" Partly, my friend, ignorance of the proper method of setting to work, but much more the want of patience and perseverance. I know nothing which requires a more constant and vigorous exercise of these virtues than pupa digging. A *total* want of success is undoubtedly disheartening; and, accordingly, in the hope of encouraging despondent "diggers," I now append a list of insects, all of which have been taken by me in this way. Having this object in view, the commonest species are included, with a description of the tree, locality, time of appearance, &c. While this may prove uninteresting to the experienced, it will, I trust, be instructive to the beginner, for whom I write. Where no other locality is mentioned, Suffolk is intended. "Priority" of nomenclature can surely be carried too far. When a name has been in use a long time and is generally known, no useful purpose can be served by changing it simply on the score of priority.

Thecla rubi. A pupa of this insect was once found under moss on a log of wood. Bucks.

Satyrus egeria. I have several times met with the pupa of this butterfly, suspended from blades of grass, when digging at the roots of trees. It is a beautiful grass-green colour, and passes the winter in that state.

Sesia apiformis. This insect, though I have not seen it on the wing, seems to swarm here, judging from the number of pupa-cases in the trunks of poplars. The larvæ in this and the allied species, as is well known, feed on the live wood of various trees. They are full-fed towards the close of autumn,

when they spin a leathery cocoon composed of the comminuted wood. They pass the winter in the larva state, turning to pupæ in April, which is the best time to look for them. Their presence may be detected by the holes or galleries, which are about the thickness of an ordinary pipe-stalk. These holes will always be found on the trunks, near the ground. Sometimes the top of the pupa-case will be seen stopping up the hole. It must then be carefully cut out, remembering that the case is frequently two inches long. Occasionally, however, the cocoons are formed in or upon the dead bark collected about the roots of large poplars, when they may easily be secured. In either instance the operation requires very delicate handling. The cases must be kept *damp*. I will not venture to advise how this can best be done.

Smerinthus tiliæ. Found commonly. Birch and elm. Prefers the narrow angles formed by the roots, getting in as far as possible. October, &c.

S. populi. Common. Various poplars; edges rather than the angles. October, &c.

S. ocellatus. Scarce. Willows. October, &c.

Euchelia jacobææ. This insect is, I believe, considered very common, yet I never took more than one specimen in England; far otherwise, however, in Ireland, where it abounds, and I have taken the pupæ in boundless profusion under loose bark on wych elms; of course the larvæ must have crawled up the trunks to form their cocoons, as they feed on the ragwort. I think it must be *local*, as that plant is very common here, yet I have not seen the insect.

Lithosia rubricollis. In abundance under damp moss, decayed moss, &c. Chrysalis short and stout, enclosed in a delicate white web: should be occasionally damped. Fir, larch, oak, &c. October, &c.

L. quadra. Occasionally. Spun up on palings in the neighbourhood of oak trees covered with lichens; also occasionally, in the crevices of the bark. End of June.

L. griseola. May be found under moss on lichen-bearing trees, preferring, however, poplars. June.

Arctia lubricipeda and *menthastri*. Common. Spun up in loose rubbish collected about the roots of various trees. October, &c. It is perhaps almost unnecessary to say that the larvæ do not feed on trees, but various low-growing plants.

A. mendica. Rarely. Under moss on trees bordering damp ditches. Gloucestershire. October, &c.

Liparis monacha. This singular chrysalis may be found by examining the trunks of oaks, in the crevices of the bark of which tree it spins up. End of July.

Orgyia pudibunda. The conspicuous yellow cocoon of this species is easily detected among loose rubbish collected about the roots of trees; sometimes under loose bark. The larva is polyphagous, and consequently the pupa may be found at various trees, preferring, I think, oak and elm. October, &c.

O. coryli. Very plentifully under moss on beech; generally at the *roots*, and not on the trunk. October, &c. Bucks.

Eriogaster lanestris. I was much surprised at finding two pupæ of this pretty insect at the roots of an *elm*: I thought it was exclusively a hawthorn-feeder, but there was no hawthorn at all near at hand. October, &c.

Trichiura cratægi. The compact egg-shaped cocoon of this species I have once or twice met with at the roots of poplar, the larva having probably wandered from some neighbouring hawthorn. July.

Pœcilocampa populi. This insect is found in various situations, and on various trees—ash, poplar, &c.; sometimes it will be found firmly glued to the inside of a piece of loose bark, or to the tree itself; at others spun up tightly among decayed leaves, dead grass, &c. It ought to be among the early captures of the pupa digger, as it is common and not difficult to find. The cocoon is black. August and September.

Platypteryx falcula. When birch is common, examine the leaves joined together, and you will not unfrequently find the pupa of this species. June, and again in September, &c.

P. unguicula. Substituting beech for birch, the same remarks apply to this as to the preceding.

Cerura furcula. Under bark and on trunks of willow, occasionally. September, &c.

C. bifida. Occasionally on trunks and under bark of poplars. September, &c.

C. vinula. On trunks of poplar and willow. September, &c.

C. bicuspis. There can be no doubt that this insect occurs in Derbyshire. It has been taken several times in the neighbourhood of Burton-on-Trent. I have found the cocoons—empty, I am sorry to say—here, on alder; but as yet all my efforts to find one from which the insect had not escaped have been fruitless. The vacant cocoons have been found almost invariably about four feet from the ground, and on the north side of the tree. Very rarely the larva spins its cocoon *on* the wood, and not in the crevices or chinks. Of course they are much more easily detected in the former situation, but I do not remember to have seen it more than once. I feel sure it must be a rare species, as, though I have examined dozens of trees, I have not found more than ten or twelve empty cocoons. The directions which follow, for finding *furcula* and *bifida*, may perhaps be more useful to others than they have been to

myself in finding *bicuspis*. It is also, I think, a good plan to *scrape* the trunk with the edge of the trowel. Alder and birch? September.

In regard to the first two of these insects, the best way, I think, to find them is to draw the finger slowly down the trunk, and carefully to examine the line thus formed, and about an inch on each side of it; they will generally be found at distances varying from one to three feet from the ground. You will almost invariably find *vinula* close to the ground.

Stauropus fagi. Once found between two decayed beech-leaves. Halton, Bucks. October.

Petasia cassinea. One female at roots of elm. July. Gloucestershire.

Ptilodontis palpina. Occasionally at poplars, but much more frequently at willows, especially when on the banks of ditches, streams, &c. When in such situations, that side of the trunk which faces the stream is often clothed with grassy sods of loose, dry, friable earth: this is the place for *palpina*; shake the sod well, and the cocoon, which is greyish and of weak consistency, will generally be found among the dry roots: it is easily distinguishable from that of *dictæa*, being much smaller (*i.e.* the cocoon), and not so much mixed up with earth. End of September.

Notodonta camelina. Very common under moss on various trees—beech, elm, &c. A little experience will soon enable the beginner to detect it: the pupa is enclosed in a weak cocoon, and, unlike the other species of this genus, terminates in a single point or spike. October, &c.

N. cucullina. Once found under moss on a beech-tree, having doubtless wandered from some neighbouring maple. October. Halton, Bucks.

N. dictæa. See remarks on *palpina*. This species forms a large cocoon, sometimes nearly the size of *trepida*.

N. dictæoides? I have found the empty pupa-cases of this species at the roots of birch. I put a note of interrogation, as, having never bred it, I am not sure.

N. dromedarius. The only pupæ of this insect I ever found were in Ireland: they were all, nine in number, taken at the roots of an alder, and produced the variety commonly known, I believe, by the name of *perfusca*: they seem to me very different from the English specimens of *dromedarius*. October.

N. ziczac. Rarely, at roots of poplar. October, &c.

N. trepida. This autumn I have succeeded in taking no less than seventeen of this fine insect: it appears to prefer a sandy soil, and does not seem so partial to *corners* as others of this genus. Oak. September, &c.

N. dodonæa. During the present and preceding autumns I have taken upwards of three hundred pupæ of this species, mixed with *chaonia*, which is much rarer here, and goes down a full month earlier. Search as usual the dry friable sods collected in the corners, or the corners themselves without any sod. The cocoon is sometimes attached to the tree, but more usually among the roots: in either case great caution is necessary. It is a good plan, when you have pulled the sod out, to put your hand in and gently feel the trunk for any cocoons which may adhere to it. Not unfrequently a sod will be found *loosely* attached to the trunk of the tree, and not among the roots. When this is the case, and the soil composing it is dry and friable, it is a favoured locality with larvæ. By taking hold of the *grass*, and pulling gently, the sod can easily be removed, and the pupæ will fall down, or, if spun up, will not uncommonly be found fixed to the trunk, or that part of the sod which lay against it. This observation is of general application. It is not easy to tell the difference between *dodonæa* and *chaonia*; but the latter is, I think, stouter, smoother, and not so glossy. Oak. September, October, &c.

Pygæra bucephala. Various trees. October, &c.

Nudaria mundana. Spun up on old walls, garden-doors, &c. Gloucestershire.

Clostera curtula. Seven. It is well worthy of notice, in regard to this species, that the larva enters the pupa state on the tree; I had imagined that it did so among *dead* leaves: this is not the case, at least not necessarily. When full-fed it joins two leaves firmly together, and remains there till they fall off. I was not aware of this fact till the present autumn: this hint may, I hope, enable others to obtain this apparently much-prized insect. I should add that they had not *turned* when I found them, but they never came out of the leaves. Various poplars (shrubs, best). October.

C. reclusa. Like the preceding, the pupa of this insect may be found occasionally spun up between two leaves on the living tree. Dwarf sallows, best. September.

Diloba cæruleocephala. The pupa may be taken (by those who want it) under the bark on the trunks of old hawthorns, crab-trees, &c. July and August.

Acronycta psi. Common under bark on various trees. October, &c.

A. tridens. I have little doubt that the pupa I am in the habit of taking under bark on hawthorns is this species, but as *psi* also feeds on that tree, and it appears impossible to separate the two species, except by breeding them, I am unwilling to speak positively. October, &c.

A. megacephala. By no means uncommon under loose bark on poplars, occasionally on willows: it is not very easy to get at, as it enters into the smallest chinks. Break off every bit of loose bark with the point of the trowel, and the pupa-case, which, with the pupa, closely resembles that of *psi*, will be found firmly glued to the surface. The cocoon is formed of decayed wood. October, &c.

A. aceris. Five: all on *oak*, not sycamore. October, &c.

A. ligustri. Abundant under moss on ash-trees. The moss must be *very* carefully torn off: the pupa-case, which is black and very tough, not *hard*, will in most cases be found adhering to the moss: if there be no moss, examine the trunk. There are often long perpendicular slits in the bark of ash-trees, and this is a favourite hybernaculum for *ligustri*. If both moss and loose bark are wanting, go to another tree. October, &c.

A. leporina. Beneath loose bark on alders. Derbyshire.

Ceropacha or. Very rarely under moss and dry rubbish on and about poplars. October, &c. Gloucestershire.

C. ocularis. Of this rare and beautiful species I took, last autumn, four; up to the present time I have taken nine more, four being unfortunately stung. The pupa is black and stout (something like *coryli*), enclosed in an extremely delicate open network of a rusty brown colour: it is very difficult to find; it frequently—nay, generally—spins on the surface of spreading moss, or barely beneath it—sometimes between two leaves; in this latter case it is soon blown away, and, in the former, falls an easy prey to the first prowling mouse: it should, therefore, be sought for as soon as possible after the change: this, I think, should certainly be not later than the first week in October. Various poplars. [I paid a visit in the autumn of 1861 to my old ground in Suffolk. On that occasion I took five pupæ of this insect. I found the following a very good method of obtaining it:—Instead of turning up the sod, lay hold of the grass lying close to the trunk, and pull it (the sod) from the tree about an inch or so; and the pupa, if there, will almost invariably be found attached to the tree, or else among the blades of grass which lie close to it. Its presence may be detected by the open network alluded to above. If, after pulling the grass from the trunk, small pieces of bark are found loosely attached to it, *i. e.* the trunk, they should be carefully removed and examined, as behind them the larva frequently spins up.]

C. ridens. Of this also rare and very beautiful insect I took twenty-six last autumn; up to the present time I have only found seven. Like the last species, it is extremely difficult to find, and should be sought for as soon as possible, *viz.* middle

and end of August.* The following directions may enable others to find it:—Detached oaks growing in *meadows*, of a dry, loamy soil, seem the best; the situation evidently preferred is the corners filled with dry rubbish, and little stunted brambles. Insert the trowel well into the earth, six or seven inches from the *angle*, and turn up the sod, bramble and all, if possible: to find the pupa, after this is done, is a work both of time and pain; it will not do, in this case, to *tap* the sod. First carefully examine the dead leaves, for they frequently spin up in them: you must then, regardless of scratches, tear the roots asunder as gently as possible. The cocoon is very weak, composed of little bits of stick, dried leaves, &c., and requires delicate handling. Indeed, the whole concern demands an elaborate manipulation. This is one of those pupæ, to find which exacts a large exercise of the two virtues already alluded to. (N.B.—Pupa diggers wearing *gloves* will return home with empty boxes.) Oak.

Bryophila perla and *glandifera*. I have taken the pupæ of both these species here (Clifton) in plenty, and bred the most lovely specimens from them. The cocoons are formed in the soft, friable mortar on old walls, or, occasionally, between the wall and the coping-stone of the walls which surround the villas in this locality. A little practice renders their detection easy. The larva works its way some little distance into the mortar, covering the place of exit with finely powdered particles of it (very much like *apiformis* on a small scale), and the eye will soon learn to distinguish between this and the adjoining material. They may be cut out with a penknife, remembering, however, to cut deep; and it is well to hold a pill-box to catch the pupa, for it is very active, and frequently wriggles out and falls to the ground. Middle of July.

Apamea unanimis. The hybernating larvæ of this species may be commonly found under loose bark on willows growing near damp ditches, in April. When you return home place them in a box with a little earth and moss, and, without further care on your part, the perfect insect will appear in June. If it be preferred, the *pupa* may be found in the same

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* I take this opportunity of correcting a mistake in the 'Manual' respecting the larva of this species and that of *flavicornis*. In that work they (the larvæ) are said to be found in *September*. This is a strange error: *flavicornis* is one of the earliest *spring* feeders, while *ridens* is found a little later in the season. I have taken the *pupa* of this latter, as stated above, in the middle of August, and, without any question, there is but *one* brood of both these species.

situations, about the beginning of June. The same remark applies to *Xylophasia hepatica* and *X. rurea*.

Xylomiges conspicillaris. Once taken at Cheltenham. August, 1868.

Xylophasia hepatica and *rurea*. Like *Apamea unanimis*, I have found the larvæ (full-fed) of both these species in April, under damp moss on stumps of trees, &c.: they require no attention. *Hepatica* I have generally found under damp moss on *poplars*.

Noctua xanthographa. This much-abused, yet, when bred, pretty insect may be found at the roots of most trees. End of July, August.

N. c-nigrum and *festiva*. Occasionally at roots of trees. July.

N. plecta. Very common at roots of various trees. October, &c.

N. augur. I was very much surprised to find two pupæ of this species, this year (1862), in a curious place, *viz.* the juncture of the branches of a pollard willow. I was looking at the time for the larvæ of *ypsilon*, and found them spun up under the loose bark. I do not imply that the larvæ eat the willow, as I believe its food is low-growing plants; but it is interesting, as showing in what apparently unlikely places pupæ may be found.

Agrotis putris. Very common at the roots of various trees. October, &c.

Tæniocampa stabilis, *instabilis*, *gothica*, *cruda*. Extremely abundant at the roots of various trees. October, &c.

T. munda. A few at the roots of oak. Gloucestershire. October, &c.

T. populeti. Of this rare species I once found a "nest" of thirteen at the roots of a poplar. It goes much deeper into the earth than most other insects. Bucks.

The last eight species may easily be found by simply shaking the sod, or loosening the earth, and, by taking a large number (I once had a thousand pupæ of *instabilis*) of the common species, some curious and beautiful varieties may be obtained without trouble.

Orthosia ypsilon. The larva of this species may be found in profusion under loose moss and bark on willows and poplars, but they must be fed. Beginning of June. The *pupa* may be taken in July, in the same situations, or spun up at the roots.

O. macilenta. Of this species, so difficult to obtain in good condition when in the perfect state, I have found only three. The chrysalis, which is extremely delicate, is enclosed in a weak cocoon. Birch. September.

Cerastis vaccinii. I turned up two or three pupæ at the roots of wych elm, during my visit to Suffolk in the autumn of 1861.

Cosmia diffinis. Not uncommon where elms abound. Spins up close to the trunk. End of July. Bucks.

C. affinis. Same time and place as the preceding.

C. trapezina. Ditto, ditto.

Cirrhœdia xerampelina. Of this rare species I took forty-seven in 1855; in 1856 I only met with eight. It is perhaps the most difficult of all pupæ to find, and, when found, the most liable to be injured. The following directions may be found useful:—They are to be sought for at the roots of ash: trees of good growth need only be tried; those on the borders of streams and damp ditches will be found most productive. The insect forms a hard, egg-shaped cocoon. Turn up the loose dry earth, rubbish, or moss about, or adhering to, that side of the tree which faces the stream; crumble it *very* carefully with the hand: should you see something resembling a cocoon, of a dark muddy colour, take it up and try whether you have obtained a prize; but in this trying lies the danger: though hard, the cocoon is extremely *brittle*, and almost the slightest pressure crushes it: the best way, therefore, when you think you have a cocoon, is to pare one end with a penknife as gently as possible; if, after scraping it in this manner, you find it *is* a cocoon, you have found *xerampelina*, and may congratulate yourself. You may look for it as early as the beginning of August, certainly not later than the first week of September. I may add that Mr. Doubleday informs me that the larva feeds on the seeds of ash trees. [Subsequent experience leads me somewhat to modify the above. I find it is by no means the fact that the pupa-case is always *brittle*. It certainly was so in Suffolk: this may have been due to the soil. In Hampshire and Devonshire, however, where I have taken it not uncommonly, the cocoon is soft and leathery. I am decidedly wrong in giving September as one of the months in which to find it: this is much too late. This insect, *croceago*, and, I believe, all the species of the genus *Xanthia*, are full-fed in June. I can speak from actual knowledge of all except *croceago* and *aurago*; but they do not turn to the pupa state for four or five weeks. This presents a double difficulty to the pupa digger—first, that of hitting the precise time *when* to dig; and, secondly, the great danger of injuring the larva if not turned, or the pupa if only just turned. As a rule, I should recommend the last week in July as the time in which to begin. You may go on till the middle and end of August, about which time, if fortunate, you may sometimes see the insect itself drying its wings on the trunks of the trees, about

a foot from the ground. This takes place generally from about two to four P.M. "Subsequent experience," however, by no means leads me to alter my opinion as to the difficulty of finding the pupa. I must acknowledge that it is hard and sometimes disheartening work, but you are repaid when you see a magnificent fellow drying his wings in the breeding-cage: to sum up, the caterpillar barely enters the earth, and the most likely place for the pupa is among the loose rubbish composed of bits of stick, dry roots, &c., collected round the trunks. All this should be most carefully and completely separated and examined. I may remark here that the pupæ of all these species most closely resemble each other, and it has often been a marvel to me how such large insects can be contained in so small a compass.]

Xanthia ferruginea, *aurago*, and *citrago*. I have found all these species, though rarely, at roots of wych elm and lime trees. August. Bucks.

X. gilvago. I have bred splendid specimens of this insect since I came to Derbyshire. The larva feeds on the seeds of the wych elm, and goes down about the same time as *xerampelina*. Like it, too, as I have already remarked, it remains a considerable time in the larva state, and is difficult to find. It spins a weak, web-like cocoon among dry rubbish. It may be found in the same way, and at the same time, as *xerampelina*, but at the roots of wych elm.

Tethea subtusa. The pupa may not unfrequently be found under loose bark on poplars. End of June.

Agriopis aprilina. In the utmost profusion: I have taken as many as twenty at one tree. This will be one of the first pupæ found by the beginner: nothing can be easier; merely turn up the earth and break it, and they will tumble out of their brittle cocoons in plenty. Oak. July and August.

Mamestra persicariæ. Common under moss on various trees. October, &c.

Hadena proteus. Not uncommon at roots of oak. Cocoon greatly resembles that of *xerampelina*. July and August.

H. pisi and *thalassina*. May occasionally be found under moss, stones, stumps, &c., on or about heaths. October, &c.

Heliothis marginatus. Once found, but I cannot say where.

Abrostola triplasia and *urticæ*. They may both be found, though not commonly, under moss on ash trees, throughout the autumn.

Plusia gamma. I have found the pupa of this insect spun up between the leaves of hollyhocks. The contrast between the dense blackness of the pupa, and the pure white of the web which contains it, is very striking.

Catocala nupta. This fine chrysalis occurs not unfrequently under loose bark on willows: it never enters the earth, as far as my experience goes. August.

Mania maura. Under bark on willows and poplars. July.

M. typica. Not uncommon under coping-stones on walls round gardens. The cocoon is formed of loose mortar.

Botys urticalis. This is the only Pyralis of which I ever found the pupa, and, strictly speaking, not even that, since it was the hybernating larva. It (the larva) may frequently be found enclosed in a comfortable cocoon under the bark of most trees; I shall not soon forget my disappointment when the perfect insect made its appearance.

Geometra papilionaria. At roots of oak. Beginning of July.

Eurymene dolabraria. This beautiful insect I used to take in plenty under moss on beech trees in Bucks: it occurs also, but much more sparingly, on oak. The larva enters the moss at the first convenient place, and therefore, in tearing it off (which should be done with the *hand*, not the trowel), great care must be taken in loosening the *edge* of the moss, for *there* the pupa is, I may say, invariably found. October, &c.

Pericallia syringaria. This very singular pupa may occasionally be found suspended by its tail to a leaf of privet or lilac, in June.

Ennomos illunaria. I once found, as stated in my first paper, a whole brood of this species at the roots of one ash tree. Not met with since. September. [I took two pupæ spun up in dead leaves lying about the roots of a lime tree, in the autumn of 1860, at Newrath Bridge, Co. Wicklow, Ireland, from which I bred the two largest males I have ever seen.]

E. fuscantaria. Once found spun up at the roots of an ash. August. Brandeston.

E. tiliaria. Two or three spun up between blades of grass growing in the corners formed by the roots. Birch. August.

Odontopera bidentaria. Common under moss everywhere. October, &c.

Crocallis elinguaria. The pupæ of this species may be taken in comparative plenty under moss on poplars, about the end of June or beginning of July.

Anisopteryx æscularia. Not uncommon at roots of elm and oak. October, &c.

Hybernia leucophæaria. One female at roots of, I think, a sycamore.

H. rupicapraria and *progemmaria.* Very common at roots of elm throughout summer and autumn.

H. aurantiaria and *defoliaria*. Also common in the same situations. Should be looked for not later than September.

The above four species may be found in little "clusters" in dry nooks formed by the roots of elm trees, and beautiful varieties thus procured; much trouble in looking for the apterous females will also be saved.

Phigalia pilosaria. Common at roots of elm. October, &c.

Biston hirtarius. Common at roots of ash. This pupa may be known by a row of dull yellow spots on each side. In October, &c.

Amphidasys prodromaria and *betularia*. Both common; the former at roots of oak, the latter at those of elm. October, &c.

Boarmia abietaria. Found in profusion at roots of fir trees in Gloucestershire. Last week in June: this time should be strictly adhered to, as the insect sometimes remains only eight days in the pupa state.

Tephrosia crepuscularia. Several, in the New Forest, under moss on oak trees. October, &c.

T. consonaria. This insect appears in the perfect state about the first week in May: the pupa should be looked for in April, under moss and at the roots of beech: it appears to be exclusively attached to that tree. Bucks.

Cidaria corylata. Common at roots of elm and lime. The pupa is enclosed in a web-like cocoon, and is greenish yellow, powdered with brown spots. October, &c.

C. russata. Common at roots of willows.

C. prunata. When currant trees rest against a wall, the pupa may often be found in the crannies and chinks. Beginning of July.

Ypsipetes elutaria. In abundance at roots of willows: most extraordinary varieties may be thus obtained. July.

Y. impluviaria. Common under moss on alders. October, &c.

Y. ruberaria. I once took about a dozen of this insect under loose bark on poplar. Bucks. April. The larva hybernates, I think; for, if I remember rightly, some had not turned when I found them in the spring.

The pupæ of the three last-named species are all black and very active.

Cidaria miaria. Very common at roots of willow. August.

C. psitticaria. Much rarer. Birch and sycamore.

The pupæ of both these species (together with that of *Epione apiciaria*, which I forgot to mention in its right place) may be found spun up in loose grass, or attached to the trunk: the latter species at willow. The pupæ of all three

have a purple bloom, and I cannot see any difference between them.

Oporabia dilutaria and *Cheimatobia brumaria*. These two common insects may be found in the utmost profusion at the roots of almost any tree throughout the summer. There appears to be an impression on the minds of some that *autumnaria* and *filigrammaria* are only varieties of these species. Of course the best way to decide the question is by breeding them: this I have not done, but out of many hundred pupæ of *dilutaria* I have never had anything like either of them. I am aware that up to this time they have only been taken in Scotland, or, at any rate, in the North. As I have had no "digging" in either of those localities, the above fact may be thought of little value. I would venture to recommend the northern collectors to dig at the roots of *elm* and oak any time during the summer, and to collect as many pupæ as possible. (N.B.—I suppose everyone knows the pupa of *dilutaria*.) Should the three insects, or two of them, be or not be produced from these pupæ, it would, I think, assist considerably in solving the question. In my opinion all three are abundantly distinct.

Eupithecia exiguata. Occasionally under bark on hawthorn. October, &c.

E. abbreviata. Occasionally under bark on oak. October, &c.

E. castigata. Occasionally under bark on hawthorn. October, &c.

E. vulgata. Occasionally under loose bark on various trees—hawthorn, crab tree, &c. October.

E. fraxinata. Of this rare species I have been fortunate enough at different times, to take seven. I believe the food of the larva is not ascertained, but I have little doubt that it feeds on ash, as all my pupæ were taken under moss on that tree. To find it, see directions under the head of *Eurymene dolabraria*. October, &c.

E. dodoneata. This very pretty insect I am in the habit of taking under loose bark on hawthorns throughout the winter and spring. It is enclosed in a delicate web.

E. lariciata. Occasionally under moss on fir trees. Clifton.

[Pupæ of *Sesia cynipiformis* may be found commonly a few inches from the ground, under the bark of the stumps of oak trees, the second year after the trees have been felled. The frass of the larvæ may be detected in the crevices where the bark has dried away from the stem, and the pupæ may readily be removed in their cocoons (which are placed between the stem and the bark) by the aid of a gouge. Pupæ of *S. culiciformis* may be found in stumps of birch trees—the second

year after they have been cut—by observing the holes made by the larvæ on the cut surface of the stumps. A small, strong, wide-set saw will be required to saw off some four or five inches of the stumps in which they are. Trying to cut the pupæ out by means of a knife or chisel is worse than useless. Probably the best way to obtain pupæ of *S. bembeciformis* is to feel along the stems of sallow- and willow-shoots, where they curve off from a main stem which has been cut two years before until one finds on the upper surface the hole, about a quarter of an inch in diameter, made by the larva. Then, by sitting on the stem so as to depress it, cut with a knife across this hole halfway through the stem—the stem will then readily split upwards, and the pupa may be found some six inches or so higher up. Four dozen pupæ were quickly obtained by following this plan. Holes were then made in a piece of wood with a centre-bit of convenient size, and the pupæ were inserted into these tail down. The wood was then placed on damp moss, and no difficulty was experienced in breeding the perfect insect. Pupæ of *S. apiformis* may be found round and in the roots of poplars.]

Remarks.—1. The above list, it will be seen, comprises no less than one hundred and thirty-seven insects, including many of the rarer species. It might have been considerably increased by adding others, which may occasionally be found in digging gardens, stubbing-up roots, turning sods of grass, &c.; but as no fixed rules can be laid down in reference to these methods, or, to speak more correctly, since I can give none, I have confined myself strictly to *trees*, on or about which all the above may be found by assiduous collectors.

2. An examination of the list will show at once that the following trees are the most productive, *viz.* poplar, willow, oak, elm, birch, beech, ash, and hawthorn. But *all* trees should be tried. Knock off the loose bark and loosen the moss on every tree you pass. I do not think there is much use in digging at the *roots* of any trees, except those mentioned, unless a particular insect be wanted, such as *Boarmia abietaria* or *Trachea piniperda*, at roots of fir, &c.

3. It will also be seen, by referring to the list, that in a very large majority of instances September and October are quoted as the best time for searching; and this is undoubtedly the case. From whatever cause or causes- such as mice, damp, mould, earwigs, &c. (I have *seen* earwigs eating a soft pupa)—chrysalids become scarcer and scarcer as the season advances, meaning by the term *season* winter and spring. If the collector, therefore, wants any particular species, obviously his best plan is to search for the pupa as soon as possible after the larva has gone down or spun up. Assuming that the

collector knows the period when the insect he wants is feeding as a larva, and its probable or usual duration in that state, a little experience will soon enable him to know how soon he ought to dig for the pupa. A fortnight will generally be found ample time. Let us take *Notodonta dodonæa* as an example. The larva of this insect is full-fed about the 25th of August. Allowing, then, a fortnight for the change, the collector should begin to dig about the second week in September; and during the ensuing three weeks of that month he will probably find more specimens than during the whole of the remainder of the season. Of course *all* the larvæ of the same species are not full-fed on the same *day*, many causes combining to produce some uncertainty in this respect; but, as a rule, the variation is not considerable. But though, for the above reason, the pupa-digger should be unusually active in his exertions during September and October, let him by no means afterwards sink into inglorious ease, content to rest on his laurels. Pupæ may be found all the year round. I seldom let anything like a fine day pass without taking a good walk into the country, trowel in hand; and if I return home in January with only *two* pupæ, instead of the *eight* which I might very probably have taken in October, I am quite satisfied. Successful or unsuccessful, I can confidently recommend the exercise.

Hints.—At the risk of appearing tedious, I append a few observations as to the method of digging, the best localities, &c. I am aware that these observations have, for the most part, appeared elsewhere; but, considering that this paper would be incomplete if they were entirely omitted, I must ask the iudulgence of my readers for recapitulating some of them.

The only implements required are a common garden trowel and a small box filled with damp moss,* for the purpose of carrying the pupæ, which should be handled as seldom as possible and with the utmost tenderness. I may here remark that the pupa-digger must not be surprised or disheartened if some of his pupæ dry up. This is caused by some unlucky, probably *unseen*, injury, inflicted at the time of capture, and, however great his caution, will not unfrequently occur. But to return. With regard to localities, the best are unquestionably parks and meadows with *scattered* timber trees. Those trees from which the surrounding grass has been worn away by the feet of cattle, and those situated on the borders or banks of streams, dykes, &c., when the soil is dry and friable,

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* Pads, such as riflemen wear when shooting, will be found a comfort when kneeling to dig.

will be found the most remunerative. When the pupa-digger enters on new hunting-ground, let him endeavour to attain an eminence which commands a survey of the surrounding fields, &c. Having accomplished this, let him cast a scrutinizing glance around. Should a lofty oak or a stately poplar be seen rearing itself in *solitary* majesty in the middle of a field, let him rejoice; and, having hastily descended from his not "bad" eminence, let him at once proceed to it, regardless of hedge and ditch. If there be a nice dry sod, ensconced in some snug corner, formed by the roots, he can scarcely fail of success. Insert the trowel, *in this instance*, about eight inches from the trunk, to the depth of four. Turn up the sod and lay it on the ground. Look then at that part of the trunk from which the sod has been removed, and, if you cannot see, feel gently with the hand for any cocoons which may adhere. Then take the sod in the left hand and tap it softly with the trowel, and the pupæ which form no cocoon, or a very weak one, such as *aprilina*, *prodromaria*, &c., will drop out. If the sod be composed of very loose, dry earth, simply shake it. Lastly, tear the roots asunder for Bombyces; if, however, the roots be strongly matted together, there is little or no use in doing this. Before leaving the tree, see if there be any nooks or crannies formed by loose bark, in which case break it off with the hand, if possible; if, however, this cannot be done, wrench it off with the trowel, taking care that it be not inserted further than is *absolutely* necessary. It is astonishing into how small a hole or crevice a caterpillar will creep. If, therefore, an insect such as *megacephala*, which spins up under the bark, be wanted, these little nooks must be carefully and *cautiously* examined. If moss be on the trunk or roots, tear it gently off, and search both the moss and the trunk. When these operations are ended, the tree may be looked upon as "done for." In digging *round* a tree, by which I mean one whose roots do not form any angles, it is not necessary to insert the trowel deeper into the earth than three inches, or farther from the trunk than four. With regard to woods, I can add nothing to what appeared in my first paper, from which I make the following extract:—"It is in vain to examine the *dense* portions; it is equally vain to dig at the *roots* of trees in such localities, with few exceptions; and you will rarely find anything, unless upon trees of a considerable growth. The thick moss which collects about the trunk and roots is the part to be examined. Bombyces are generally (almost invariably) found under the moss which covers the spreading roots, and not on the trunk. The best localities in woods are the borders and open places; and it is curious that such places, when elevated or facing the north, seem to be the

most productive." [This observation, *viz.* "facing the north," subsequent experience leads me to apply to all pupa digging. The vast majority of pupæ will be found on that side of the trunk which faces the north. This circumstance I attribute to the fact that in this situation they are less exposed to sun and rain. We all know that exposure to the sun is fatal to pupæ, and therefore an infallible instinct leads the larva to select the shadiest side. I believe that rain or damp is equally injurious to them, and that therefore they choose the northern side as the driest. I am well aware that some will differ from this opinion; but however doubtful the cause, the effect is certain: and so satisfied am I on this head that I go first to the northern side, and if it present an unfavourable appearance I, as a rule, leave the tree. As having some bearing on this point, I may mention that the insects themselves, when at rest on the trunks of trees, are almost always found on the northern side. In the former part of this paper, when speaking of *dictæa* and *palpina*, I mentioned, as the most likely places for finding the pupa, poplars and willows bordering upon streams, and especially the dry sods formed on the sides facing the stream. It is, however, wholly useless to examine trees in this situation when the roots and trunks are liable to be submerged by the overflowing of the stream. In such cases there is usually a water-mark, below which a pupa never will be found. An unerring instinct seems to warn the larva of its probable fate should it venture below this water-mark.] Touching hedgerows, I must so far modify my former wholesale condemnation of them as to say that I once found two pupæ of *ocularis* in such a situation. It is in fact the *trees* in hedgerows rather than the hedgerows themselves that are to be condemned. As Mr. Douglas justly remarks, in his highly interesting and instructive little book, the 'World of Insects,' p. 116, "Pupæ must be there," *i. e.* in the *banks* on which the hedgerows are. I shall most thankfully receive any information as to the *modus operandi* in this case from those who have tried it. I imagine that Noctuæ, and not Bombyces, will generally be found in such situations. [Since writing the above, I find that the pupæ of *xerampelina* and *gilvago* may be taken in such situations, the former at ash, the latter at wych elm. When *large* trees are in such places, there is frequently congregated about the roots a quantity of dry rubbish, consisting of bits of stick, dead leaves, &c., mixed with light earth. The larvæ are very fond of spinning up in this stuff, or just below the earth, and it should therefore be carefully examined. Observe—In turning up sods, earth, or rubbish, the trowel should never be inserted *parallel* with the tree, but with the *point* of it *facing* the tree. Also—When the trowel is

once inserted, do not take it out, but press it up at once to the tree. If the trowel be only inserted say half way, and the sod loosened, not unfrequently pupæ will fall down; and the second insertion of the trowel will inevitably result in the severing of or crushing them. Again—When the trowel has been driven up to the trunk, great care must be exercised in removing the sod from it. If you can do so without *pulling* it off, so much the better; if not, do it as gently as possible, since larvæ often spin up among the roots of the grass, and the violent wrenching off of the sod will crush them. In the occasional records of insects taken in the pupa state, I observe the frequent use of this expression, "Pupa, by *raking*." What is the meaning of the term "raking"? [In reply to this question, Mr. Gregson, of Liverpool, forwarded a communication to 'The Zoologist,' p. 5432. It would appear from it that raking is a method employed to obtain perfect insects, not pupæ, though some may occasionally be found. It is not necessary therefore to say more on this head. Subsequently a communication appeared in the same work, p. 5538, from Mr. Edleston, of Manchester, from which I make the following extracts:—"In this district many thousands of chrysalids are annually procured from the roots of poplar, &c.: with the exception of one *chaonia*, I am not aware of a single rarity bred; certainly none ever fell to my share. . . . The great point in favour of digging, even in a barren district like this, is that it enables the collector to employ his spare time in the winter and spring months, instead of being idle. Judging from my own, and the result of others', diggings, I have not the slightest hesitation in saying the system must rank far below the usual methods of procuring insects; for instance, compare the results of a few nights' attention to sallow blossoms, if *instabilis*, *populeti*, &c., are wanted, or a stroll into the woods at night with a lantern in October and November, and again in spring: he must be an extensive proprietor of boxes, if not fully satisfied with abundance of common insects in the finest condition. A trowel is never used in this district for digging, but a far more effective instrument, in the shape of a small three-pronged garden fork, with the prongs bent downwards, requires less *exertion* (the italic is mine) than a trowel in pulling up grass, sods, &c." I desire to make a remark or two on these extracts. There can be no question, of course, that in a "barren" district, pupa digging, like other methods, must be comparatively inefficacious; nor is it to be denied that some localities are much more productive than others. But, if I understand Mr. Edleston rightly, he implies that pupa digging is far inferior to sugaring, ivy, sallows, &c. If so, I would remark—1st, that not a single Bombyx and very few Geometræ can be obtained in any of

these ways; 2ndly, that females are rarely procured; and 3rdly, that of those insects which *are* captured, a considerable percentage are more or less injured and rubbed. As regards the comparative value of these methods and pupa digging, I would also refer my readers to the foregoing list of insects captured by myself in the latter way. Again, I must entirely dissent from the opinion, or rather assertion, that a small three-pronged garden-fork is a "far more effective instrument" than a trowel. In one sense, that of destroying pupæ, I have no doubt it is. Mr. Edleston complains of the "exertion" required to pull up grass, sods, &c., with a trowel. I am afraid he does not exercise sufficient "patience." Pulling up the sod is a very small part of the business. It is the patient, careful *examination* of the sod which constitutes pupa digging. I have a strong suspicion that it is the absence of this careful examination which produces the absence of pupæ. I am the more inclined to this view from observing that of the twelve species (omitting *megacephala*, which spins up in the bark) enumerated as being commonly taken, two only—*dictæa* and *bidentata*—make a webbed cocoon, while the remaining ten merely enter the earth. Now, the pupæ which are in webs require the patient, careful examination above alluded to, while those which are merely in a cocoon of earth simply require the sod "to be well shaken, and they are taken." From this fact I draw a conclusion unfavourable to the *industry* of the Lancashire pupa diggers, provided always that the insects occur there. Mr. Edleston says that *chaonia* has once been taken in this way. That species therefore occurs in his district. If *dodonæa*, *trepida*, *ocularis*, *xerampelina*, or any other good insects are found in Lancashire in any stage, and there are suitable trees, I think I may undertake to say that I will find more than *one* pupa, and if Mr. Edleston will honour me by reading and acting upon the suggestions contained in this paper, I think *he* will too.]

There is no use in trying hard, sticky, or clayey ground; but the following hint will be found valuable: always *replace* the sod when you have done with it, or at least the *débris*. When first taken up, the sod may be so hard as to render it impossible for the caterpillar to penetrate it; but if, after being loosened by the pupa-digger's manipulation, it be restored to its place, the larva, which in the original instance would have wandered away to some more convenient spot, will now find one ready made, and will almost certainly make use of it. This has been evidenced to me in the most unmistakable manner, in proof of which I may adduce the following example:—One day in June I came to a most unpromising-looking oak. Observing a little angle, I inserted the trowel,

and found the soil as hard as a board; nevertheless, I turned up the sod, shook it, and, having found nothing, loosely replaced it. In the following September I returned to the same tree, and, having unsuccessfully dug round it, came to my little (it was not more than three inches each way) sod, and raised it with anxious hand, when, lo! to my delight and astonishment, *five* pupæ of *Notodonta dodonæa*, all joined together in a little cluster! It is obvious that the above plan will be of no use during the winter months, but can only be made available while the larvæ are feeding, *i. e.*, in the late spring and early summer months. It will then be said, "You dig all the year round?" I answer, certainly: September and October are the most *productive* months, it is true; and August and September will be found the best time for the autumnal species; but that is no reason why the other months should be neglected. Of course I dig much more sparingly during the spring and summer, at which period insects may be taken in the larva and imago state; but I seldom go out without my trowel; and I can confidently recommend the collector in want of any particular tree-feeding Bombyx or Noctua to prepare a comfortable home for the larva, in the manner given above.

When the ground is very wet do not try *digging*. Rather examine moss, loose bark, &c.

With regard to the question, which will probably be asked by my readers, "Which are the most *likely* trees?" I answer that general directions on that head will be found scattered through the paper; and I would only add in this place that it appears to me useless to try any trees but those of considerable growth, and that when the trunks or roots of such trees are thickly matted with ivy no pupæ will be found. But the uncertainty on this point is truly extraordinary. In my first paper I gave an instance; I now subjoin another. In the neighbourhood of Brandeston is a park, belonging to the Duke of Hamilton, which is filled with fine old timber oaks, and is a grand hunting-ground for the pupa digger. On one occasion I came to a meadow, adjoining this park, in which were about sixteen oaks, all fulfilling the necessary requisites for "likely" trees—old, filled with angles, and a dry soil. Out came the trowel, the box was prepared, and I began with number one. I dug for about two hours; at the expiration of that time I looked into my box, and found the result to be three *instabilis*. There remained one tree, which did not seem to offer any advantages over the others; yet at that one tree, in a corner about the size of a good large plate, edged with loose grass, I took the following, *viz.* three *trepida*, seventeen *dodonæa*, three *prodromaria*, seven *hirtaria*, and two or three dozen

cruda, *gothica*, *plecta*, &c. This is a simple *fact*, and in reference to it I would ask, "Can anyone assign even a plausible reason for so singular a circumstance?" The same thing, though in a less degree, occurs every day, and seems to set at nought anything like fixed rules. Lastly, I wish to express my thanks to Mr. Gordon ('Zoologist,' 5537) for reminding me of a locality omitted by me, *viz.* the tops of moss-covered clumps in woods, plantations, &c. Though not perhaps very productive, yet, as Mr. Gordon observes, pupæ and larvæ may occasionally be found in such situations. All that is required is simply to remove the moss and examine it, as well as the bared surface of the stump. To sum up, pupæ may be found almost anywhere and everywhere—under moss on large stones and boulders, in the decayed stumps of old trees, behind the loose bark on palings, between dead leaves, under moss on banks, &c.

If this paper be of any use in enabling the collector to fill up some of the blanks in his cabinet with his own hands (and who would not rather do so with his own hands than with those of others?), I shall feel well repaid; and any letter addressed to me shall be willingly and promptly attended to where further information may be desired.

That pupa digging is much on the increase I infer from several circumstances, among which I may mention the comparatively frequent record of insects captured in this way. Surely the most desponding must be nerved to renewed efforts when he reads that *bicuspis*, *ilicifolia*, *fluctuosa*, and *conspicillaris* have rewarded the enthusiastic pupa digger.

In confirmation of the above opinion I here give an extract from the letter of a highly esteemed correspondent, Dr. Bree, of Colchester:—"I met some young boys, a day or two ago, digging round some trees. To my horror I found that they had read of the —— (modesty forbids my giving the adjective here added) Mr. Greene in the 'World of Insects,' and were exterminating all my game. They had got about a dozen under an elm tree!" I hope Mr. Douglas may be as much pleased with this circumstance as I was.

I hope it will be borne in mind by my readers that the remarks, hints, &c., contained in this paper are not intended as incontrovertible dogmas, but merely as the results of my own experience and observation.

And now I will conclude with one, literally *one*, word of advice to the incipient pupa digger, and it is this: PATIENCE!*

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* Since the above remarks were written, pupa digging has largely increased; and many insects, comparatively rare, especially among the Bombyces, have become common.

Rearing.—Copious directions for rearing larvæ are already before my readers (p. 3). I, in common with others, have often been asked what is the best way of preserving pupæ. It is very difficult to give any good or *safe* advice on this point. In a little book by Mr. Richard Shield, called 'Practical Hints respecting Moths and Butterflies,' is a description, which I copy, of a box for rearing the pupæ of Micro-Lepidoptera:—"Obtain one or more boxes of any convenient length or breadth, but not less than six inches in depth (either divided into compartments or not), and fitted with a lid, having a large space cut out of it to within an inch of the margin; this open space to be covered with either close-wove wire or old calico affixed with thin glue. In the bottom of the box, or of each compartment, bore with a centre-bit one or more holes, about two-thirds of an inch in diameter; cover these with pieces of perforated zinc, tacked down; place on the bottom of each box or compartment moderately-sized pebbles or sea-gravel, to the depth of about half an inch, and on this again, to the depth of two inches, the earth on which to lay the pupæ, composed of garden mould, silver sand, and thoroughly rotten wood from the heart of an old tree; on this, after being made smooth, distribute your pupæ in such a manner, according to their size, that, when covered, none are more than half an inch below the surface, and cover the surface of the mould with a layer of moss about half an inch thick. The inside of the box should be rough, and the box itself should be raised on pieces of wood, or have pieces of wood fixed to the bottom in such a manner that it may stand clearly above the floor. By this arrangement you may damp your pupæ with impunity, as it is impossible for them to become saturated with stagnant water, owing to the bottom drainage, and the moss at the top prevents undue evaporation by absorbing a certain quantity of moisture, and thus striking a medium between the two extremes of wet and drought." The description of this very elaborate apparatus is given *in extenso*, as some may like to try it. It may very possibly be necessary for the successful rearing of the Micro-Lepidoptera, and will doubtless serve also very well for larger pupæ, if the collector be disposed to take so much trouble. At the same time it may be thought that it is not required. A box of any kind, provided it be not less than six inches in depth, answers the purpose. It should have *rough* sides, and of course a gauze-covered lid. A thin coating of fine sifted garden or any other mould may be laid on the bottom of the box, and, if you like, some moss upon it. Only be careful first to *boil*, and then *thoroughly* dry, the latter. For all the larger pupæ—meaning, by this, Sphingidæ, Bombyces, and Noctuæ—nothing more is required than simply to lay them on the moss,

and then—leave them alone. For the smaller pupæ a different plan may be adopted, which is recommended as at least worth trying. Procure a number of lids of *tin* boxes, or shallow white jam-pots, in which place the pupæ, having taken them out of their cocoons. My idea in doing so is that the *coolness* is of advantage, and I have certainly succeeded, since I employed this method, in rearing a larger proportion than heretofore. Put all the pupæ of the same species in one of these lids or jam-pots, with a label having the name, if possible, of the insect. A tolerably accurate idea both of the quantity and quality may thus be formed. The especial merit which Mr. Shield seems to claim for his apparatus is that you are thus enabled "to damp your pupæ with impunity." Possibly. But, whether right or wrong, I have long since decided in my own case *not* to damp pupæ: for I have already endeavoured to show in another place ('Zoologist,' 8008) that, in my opinion, pupæ in a state of nature do not require moisture. As some of my readers may not see that periodical, I will venture to make a few extracts from that communication. It was made in reply to a question asked by the Rev. E. Horton, "Are pupæ killed by floods?":—"Mr. Horton considers that this question may have some bearing on the disputed point as to whether pupæ in confinement should or should not be damped. I agree with him. At least it suggests an inquiry. In former years, as Mr. Horton rightly observes, I felt doubtful on the subject; but later experience has convinced me that, on the whole, it is better *not* to damp them. On the supposition that in their natural state pupæ require and have moisture, some collectors have felt themselves bound to try and supply it, and in doing so have experienced much difficulty in applying it in such a way as, on the one hand, not to give too little, or, on the other, too much. I am, however, most decidedly of opinion that this supposition is incorrect, and is not warranted by facts. There is one fact which every skilled pupa digger must have observed, *viz.* that in the vast majority of cases pupæ are found on the northern or eastern sides of trees, *i. e.* the sides least exposed to rain. Moreover, so far from the larvæ choosing damp or moist places, the reverse is the case, as every pupa digger knows. I am so satisfied now on these points that I rarely trouble myself to examine the moss, or dig, except on those sides, or in dry places. From these well-known facts I infer, nay, conclude, that pupæ in a state of nature do not necessarily require moisture, or at any rate very little." There is doubtless a humidity in the open air which may be of service to them, but, as that perhaps cannot be obtained indoors, we must be content with a good airy room. Some pupæ, however, *must*, I believe, be kept moist, as various species of *Leucania*

and *Nonagria*. The stems in which are the *Nonagria* pupæ should be stuck upright in a saucer of wet sand, and this saucer placed in a box—a band-box is very convenient for this purpose. In fact, before dismissing the subject, I may remark that there is no part of collecting in which it is more difficult to give advice, or in which the beginner will be more called upon to trust to his own wits and experience, than that of the best way of preserving pupæ. If it is considered necessary to apply moisture, I have found it a good plan to cover a flower-pot in which are pupæ for a few hours with a *damp* sponge.

Forcing.—If it be desired to "force" pupæ—that is, to make the perfect insect "put in an appearance" before the usual time—it may be done by putting them in a greenhouse or hot-house, if you have one. If not, a very successful plan is to place them (in a box with a little earth and moss) on the chimney-piece in a room where a fire is kept constantly burning. Mr. Warren, of Cambridge, forces the pupæ of Micro-Lepidoptera, by placing them in tin boxes at the sides of a fireplace, so that they are brought under the influence of a very gentle warmth. Occasionally he puts a few drops of water, so that the pupæ may not dry in the process. By this means. he states, he can be pretty sure of obtaining the imago in a fortnight or three weeks. Of course, care should be taken not to put the boxes where they will receive the direct heat of the fire.

Mr. Elisha has been very successful in forcing pupæ of the Micro-Lepidoptera, but has a much more elaborate mode. He maintains a uniform temperature in his breeding-house, by means of burning gas. It has been thought by some that forcing tends to *cripple* the insect. I have never found this to be the case. It must, however, be borne in mind that if you want them to "pair" in order to obtain eggs, you must not force them, as in this case the food-plant would not be ready. If the pupa be taken out of the *cocoon*, it is a good plan to place it on its "face." If laid on its back or side, it will not unfrequently happen that the moth, having cracked the shell, will be unable to get rid of that part of it which contains the legs. This will inevitably result in a "cripple." It may be a fancy only on my part, but I think that this catastrophe is less likely to occur when the pupa is placed, so to say, "on its legs." If the pupa is *not* removed from the cocoon, I cut out a little circular bit, some short time before the expected appearance of the moth, so as to enable it the more easily to creep out. If the pupæ are left undisturbed in the moss or earth, these proceedings are of course unnecessary. Though, as already observed. I am myself an advocate for removing pupæ,

it is but fair to confess that in doing so one increases the likelihood of cripples, from the fact that they thus want that natural *purchase* which is supplied to them when buried in the earth, or spun up in moss, &c. The choice of the two methods must be left to the discretion of the collector, only observing that, if the former (the removing them) be adopted, the pupæ should be left on a *rough* surface.

THE IMAGO, or PERFECT INSECT.

The remarks which follow under this head, as to catching, setting, preserving, &c., have been drawn from three sources,—the observations scattered through various works on Natural History; the observations and hints of friends; and my own personal experience,—in order that where there are two, three, or more methods of doing the same thing, the beginner may choose that which strikes him. The indulgence of the reader must be asked if what follows at times appears to be discursive, since, where there are so many points to be considered, it would be difficult, not to say impossible, to preserve a strictly connected arrangement.

Localities for insects in the perfect state may first be considered, commencing with the butterflies, or day-flying species. Some are *rare*, that is, uncommon *everywhere*, as *Pieris daplidice*, *Argynnis lathonia*, *Lycæna acis*, and *Vanessa antiopa;* others are *local*, that is, confined to a particular district, county, field, or even part of field, but in comparative abundance there; such are *Papilio machaon*, *Erebia epiphron*, *E. æthiops*, *Lycæna arion*, *H. actæon*, and *Melitæa aurinia*. Others are common everywhere, as *Epinephele ianira*, *Vanessa urticæ*, &c., Again, it is to be observed of butterflies *in general*, that different species, whether common or uncommon, are found only in localities of a certain *description* or *kind*, beyond which or without which it is vain to look for them. Thus, for example, some species are to be found only in woods or on the borders of woods, as *Limenitis sibylla*, *Apatura iris*, *Leucophasia sinapis;* others in marshes; others in mountainous, chalk, or heath districts; others in fields and meadows. It would be impossible, in such extensive Orders as the Bombyces, Noctuæ, and Geometræ, to give the separate localities for each species; but as the "butterflies" are only sixty-seven in number, and as they are generally the Order first attacked by the enthusiastic beginner, I will, as far as I am able, draw out here a list of the *kind* of localities they frequent:—

Woods or borders of woods.—*Pieris cratægi*, *Leucophasia sinapis*, *Pararge egeria*, *Limenitis sibylla*, *Apatura iris*, *Vanessa c-album*, *Argynnis paphia*, *A. aglaia*, *A. adippe*, *Melitæa athalia*, *Nemeobius lucina*, *Thecla betulæ*, *T. quercus*, *T. pruni*, and (where holly abounds) *Lycæna argiolus*.

Fens and marshy places.—*Papilio machaon*, *Melitæa aurinia*, *Polyommatus dispar*.

Downs and dry hilly meadows. — *Melanagria galatæa*, *Satyrus semele*, *Cœnonympha pamphilus*, *Vanessa cardui*.

Chalk downs.—*Lycæna corydon*, *L. bellargus*, *L. minima*, *L. astrarche*, *Nisoniades tages*.

Mountainous districts and moors.— *Erebia epiphron*, *E. æthiops*, *Cœnonympha typhon*, *Lycæna ægon*, *L. arion*.

Generally distributed throughout lanes, meadows, clover fields, &c. — *Gonepteryx rhamni*, *Colias edusa*, *C. hyale*, *Pieris brassicæ*, *P. rapæ*, *P. napi*, *P. daplidice* (near coast), *Euchloë cardamines*, *Pararge megæra*, *Epinephele ianira*, *E. tithonus*, *Cœnonympha pamphilus*, *Vanessa atalanta*, *V. io*, *V. antiopa*, *V. polychloros*, *V. urticæ*, *Argynnis lathonia* (near coast), *Thecla w-album*, *T. rubi*, *Polyommatus phlæas*, *Lycæna icarus*, *Hesperia thaumas*, *H. sylvanus*.

Melitæa cinxia.—In the Isle of Wight.

Hesperia actæon.—Lulworth Cove and Swanage.

Lycæna acis.—Rough pastures and railway-banks.

L. argiades.—On heaths; may readily be passed over as *L. ægon*.

Hesperia lineola.—Common towards mouth of the Thames.

It is "long, long ago" since I collected *butterflies*, having obtained all the species, except three or four; but it is probably the happiest period of the collector's entomological career. Then *everything* is rare; and one looks back with something very like regret to the time when a number of *Epinephele ianira* used to be pinned with pride into the crown of the hat, and think it a good day's work, or gloat over a specimen of the "Silver Y." But, once more to business. Bright sunny days are, as a rule, the days for butterfly-hunting, excepting perhaps for the Lycænidæ, which may be found on grass-stems and on flowers during dull weather. *Thecla rubi* is sometimes then quite common on the ox-eye daisy. Specimens of the genus *Vanessa* may be attracted by sugar; on more than one occasion *V. antiopa* has been taken in this manner. The sap which exudes from the trees injured by the goat caterpillar is also very attractive, also decaying fruit.

Net.—The net to be employed for catching Lepidoptera consists of a hoop or ring of iron (sometimes cane), about three

feet in circumference; if of iron, it should be as thick as a pipe-stem. It may, however, be made as large or as small as the collector wishes. The *larger* it is the better chance of entrapping the insect; the *smaller*, the more easy to wield. To this ring is attached a bag-net, about two and a half feet in depth, made of green gauze, and with the corners rounded off. Some prefer white: in my judgment green is the best. To prevent the edges from being frayed, a strip of stout calico should be sewn round the hoop, and the gauze fastened to it. The hoop must next be screwed into a stick (the lighter the better), and the instrument is complete. Folding-nets—handy for the pocket—may be obtained of any dealer in entomological apparatus. For all ordinary purposes a stick three feet long is amply sufficient. For some of the high-flying butterflies, as *Apatura iris* and *Thecla quercus*, a much longer handle will of course be required. For Geometræ, which may be found in the *daytime* by beating hedgerows, trees, shrubs, &c., a much smaller net, which can be easily wielded with one hand, will be found very serviceable. The net in this case may be two feet in circumference, a foot and a half in depth, and the handle about a foot. With the ordinary net described as above, I suppose the anxious and excited beginner to be in a wood, about nine a.m. on a bright summer's day. It is little use trying for butterflies before this hour. He walks slowly down one of the ridings; his eyes everywhere; the net firmly grasped in both hands. Suddenly something, shining gorgeously in the sun, sails past him, and settles on a flower or shrub some half-dozen yards in advance of him. "It is *Argynnis paphia*, fresh from the chrysalis!" With stealthy step and bated breath, and trembling with excitement, he creeps nearer and nearer, his eyes glued to the glorious creature, as, with expanded wings, it basks in the sun. Just as he gets within distance, however, there is an ominous *folding* of the wings (most collectors will know what I mean) preparatory to flight. Rashly he makes a strike. He is one inch short of the mark, and the next moment *paphia* is over the tops of the trees. But if better fortune attend him, a dexterous sweep, and a quick turn of the net with the wrist, and the prize lies imprisoned at the bottom, where for the moment we will leave him. Again, to vary the scene. I see a strange, and at first sight an unaccountable, spectacle! It is that of a young man rushing frantically through a field of clover under a burning sun. In his right hand is held aloft, and brandished like a banner, a bag-net. His hat is gone, his coat-tails are streaming behind him, and from the aforesaid coat-tails proceeds a strange and mysterious rattling, as of pill-boxes. About two yards in front of him is a bright orange-coloured butterfly. His eyes are fixed

with undeviating steadiness on that butterfly. It nears a lofty hedge. One mighty effort—a vigorous sweep of the net—the butterfly sails calmly over the hedge, and the young collector falls flat on his face! These little catastrophes will happen, and not unfreqently: nor is the slight, perhaps, but inevitable ruffling of the temper, produced by them, much calmed down by the encouraging remark from a *cool* and unsympathising bystander of "Go in and win!" just when you have lost. But, supposing the butterfly safely netted, avoid being in a flurry. It is a trying thing to see a beautiful specimen fluttering in the net, and to fear that it is injuring itself while so doing. But be assured that being in a hurry will not mend matters. Never attempt to lay hold of a butterfly while it is *fluttering*. When it rests, and its wings are raised up over its back, then dexterously seize it through the net by the legs, and give it a good squeeze. This will do very well for large butterflies; but a good deal more will be said on this matter hereafter.

It is essential to a successful butterfly expedition that the day be warm and sunshiny, though an intensely hot or very sultry day is by no means the best. Butterflies are rarely on the wing before nine a.m., or after four p.m. The most likely localities, *in general*, are: open glades and ridings in woods, and especially flowery meadows in or on the borders of them; lanes; fields, particularly clover; heaths; chalky districts, &c.

With regard to *moths*, including under that head the Sphinges, Bombyces, and Noctuæ, they, like the butterflies, may be classed as rare, local, and common. Many of the Sphinges fly by *day*, and are captured like butterflies. Such are *Procris statices* and *P. globulariæ*, the genera *Anthrocera*, *Sesia*, and *Trochilium*. *Macroglossa stellatarum* is also a day-flier, but is by no means easily captured. The larger Sphinges are generally taken in the larva state, excepting perhaps *Chærocampa celerio*. The young collector should carefully look out for what are called "Clear-wings," *i. e.*, the different species of *Trochilium*, *Sesia*, &c., for they so closely resemble bees, wasps, and ichneumons, as easily to deceive an inexperienced eye; they appear to prefer shining leaves on which to sun themselves. *S. ichneumoniformis* is best taken, where it occurs, by sweeping the net over the short herbage.

There is only one way of taking Bombyces (I mean the perfect insect) which offers a reasonable prospect of success. This will be spoken of hereafter. They may, however, occasionally be found in the daytime by beating, or settled upon the trunks of trees in woods. The two *best* methods of procuring Bombyces are pupa-digging and larva-hunting, and these are the

two methods to be recommended not only to the beginner, but to all collectors.

With regard to Noctuæ, speaking of *day* hunting, little, comparatively speaking, can be done. The assiduous collector will, indeed, not unfrequently be rewarded by finding good insects settled on palings and on the trunks of trees in various localities. Some species fly by day, e.g., *Heliothis dipsaceus*, *Anarta myrtilli*, *Heliodes arbuti*, *Agrophila sulphuralis* (in the afternoon), &c.; whilst *Plusia gamma* is often a perfect pest. N.B.—The northern and north-eastern sides of trees are the favoured localities.

In the Geometræ much more (perhaps more than at any other period) may be done during the day. They are very fond of settling on trunks, which, when in woods, should be carefully examined, as also palings. It is astonishing how accurately, after a little practice, the eye will learn, even at a considerable distance, to detect the presence of a moth on a tree or elsewhere. Geometræ, moreover, are much less *exclusive* in their habitats than most other insects. They may be found almost anywhere—indoors and out of doors, in hedges, grass, trees, shrubs, heath, flowers, meadows, &c. On a dull day, when there are no butterflies out, or you don't want them, take a light stick and the small net described above. Beat the hedges, trees, &c., and as the moths fly out you can easily capture them. I must, in passing, urge upon the beginner the necessity of thoroughly searching a locality. The reasons for this are obvious:—1st. The food-plant may be rare, or only in scattered patches, and consequently the moth will be more or less confined to those spots. 2ndly. The atmosphere, even in the daytime, has a great influence upon insects, at one time inducing sluggishness, at another activity. In the former instance beating is almost useless, while in the latter a tap will set them flying in all directions. It is plain therefore that assiduous and constant beating, even in an apparently unproductive locality, is desirable. 3rdly. There can be no doubt that many species have fixed hours for emerging from the pupa, and rare insects have been found drying their wings where, an hour or two afterwards, no amount of beating or searching would detect them; for it may be laid down as an almost invariable rule that an insect, as soon as it has thoroughly dried its wings on a trunk, stalk, &c., will then creep down and hide itself in the surrounding herbage. 4thly. From some cause or causes at present unknown, an insect will be plentiful to-day, and wholly disappear to-morrow. Many and many a beginner (myself among the number) has been deceived in this way. "Oh, that's a common thing! I can take it at any time." How often has this been said! But

a few days afterwards a friend perhaps writes and says, "I should be much obliged for some specimens of *A*—— *c*——, as I hear it is common with you." Accordingly, next morning you take your net, and, full of benevolent intentions, you arrive at the favoured locality, bringing an unusually large collecting-box, or a number of pill-boxes, for the purpose. But the insect has disappeared! In vain you thrash the trees, or kick up the herbage; in vain you cast a searching and scrutinizing look above, below, around. Not even a wasted specimen is to be seen. On your return home you sit down to the unpleasant (I speak from experience) task of writing to your friend to say that you are very sorry you cannot send him the insect *now*, but you hope to take it again next year, and will be sure to remember him. But, my young friend, when next year comes you may be a couple of hundred miles away, or the insect may not appear in its old haunts. Of this latter occurrence we have a very remarkable instance in the case of *Erastria venustula*. It is on the authority of no less a person than Mr. Henry Doubleday. "On the 29th of June (1845), whilst walking with a friend through a heathy part of the forest, I observed several specimens of this pretty little species flying over and alighting upon the common fern: not having any entomological apparatus with me, except a couple of pill-boxes, I only secured two specimens. The next day I again visited the spot, but could not see a single individual. Mr. Bentley informs me that his father captured this insect in our forest more than forty years ago; but I believe no one has since met with it in Britain, except myself; at least I am not aware of any other captures." ('Zoologist,' iii. 1085.) Observe, forty years had elapsed between Mr. Bentley's and Mr. Doubleday's capture of this insect. Nor is this all. Mr. Doubleday took his specimens in 1845. The insect then again disappeared, and was not re-discovered till 1860—a period of fifteen years. Many like instances might be brought forward (as *Micra ostrina*); but this will be sufficient to show that we should not "put off till to-morrow what may be done to-day."

To return to the subject of beating. When a moth is *in* the net, the next question is how to get it *out*, and this is by no means so easy a matter as at first sight might appear. The way in which this is commonly done is by "PILL-BOXING." A box large enough for the purpose is inserted into the net, and the moth, being beguiled into it, is transferred to the coat-pocket, an operation which requires a little practice. The majority of moths may be kept in the net by simply blowing them down as they flutter up the side, and while they are fluttering or quiet the pill-box may be placed over them. If

the top of the box, covered as it then will be by a part of the side of the net, be then placed against the cheek, the lid may readily be passed under the net and over the box. An adept at pill-boxing will, however, box them with one hand, by pressing one side of the lid and box against the thumb, using that side as a sort of hinge, and separating the lid from the box on the other side by means of the fore-finger for the box and the second finger for the lid. Pill-boxes with glass bottoms are by far the best sort. The killing-bottle may readily be used, if it be desired to kill your capture. The KILLING-BOTTLE may be made as follows:—Take a wide-mouthed bottle, having either a well-fitting stopper or bung, and dissolve some cyanide of potassium in the smallest possible quantity of water—and a very small quantity indeed only is requisite; then, when you have a saturated solution, put in a quantity of plaster of Paris, and gently ram down with a round stick having a flat end—a ruler will do. Then shake out any plaster which does not adhere, and wipe the bottle above the mixture clean, and your killing-bottle will be ready for use. Some people simply put in a few lumps of the cyanide, and then pour over them plaster of Paris mixed (to the consistency of cream) with water. The plaster then sets hard. The former plan, however, has this advantage, that although sufficiently hard for all practical purposes, it can readily be broken up when you wish to renew the poison. It must be borne in mind that cyanide of potassium is one of the deadliest poisons known, and that you cannot take too great care when using it. The old mixture, when removed from the bottle, should be buried in the ground in some place where it will not be disturbed. Insects will soon be stupefied in a bottle of this sort, and can then be pinned, and should be pricked in their thoraces under their wings by a fine pen dipped in a *saturated* solution of oxalic acid, or by a pin smeared with the nicotine from the stem of a foul tobacco-pipe. If they remain in the bottle until quite dead, they will be found to be too stiff to set readily, but by leaving them in the bottle some hours this *rigor mortis* will have passed away.

Mothing.—We may now suppose the day drawing to a close, and with it we bid farewell to the butterflies. On warm, dusky summer evenings, moths of all Orders begin to fly. The first among Macro-Lepidoptera to appear, generally, are the Geometræ. From about eight till a little after nine they may be captured with the net, as they flit about the hedgerows, or open places in woods. The Bombyces and Noctuæ, being such rapid fliers, are not easily captured in this way, unless hovering over or settled upon some favourite flower. Mr. Brown,

of Burton-on-Trent, recommends the following plan, *viz.*, "to choose the margin of a wood well-hedged, and the ditch filled with herbage, by the side of which I walk, holding in my left hand a small pocket-lantern, with a bull's-eye glass, secured by a ribbon round my neck; and in the other hand a bag-net. The moths will ever and anon make their appearance from among the trees, and will skirt along the hedge; and if the lantern be turned towards the wood, they may be struck with the net the moment they appear within the illuminated disk. By this means I have caught many species which could not be allured by a stationary lamp." ('Zoologist,' i. 178.)

It is scarcely necessary to say, however, that the great attractions on certain nights for moths (Noctuæ) are "sweets," whether natural or artificial. The following is a list of some of their favourite flowers:—

Honeysuckle.—In the neighbourhood of Ely, where *Chærocampa elpenor* and *C. porcellus* are more plentiful than they are here, I have taken several specimens of each from this plant, with a few of *Sphinx ligustri*, *Cucullia umbratica* (in abundance), *Plusia iota* and *P. chrysitis*.

Jasmine and *Valerian.*—Among others, I have taken from these *Chærocampa porcellus*, *Trochilium tipulæformis* and *T. myopæformis*, *Hecatera dysodea*, and many of the Agrotidæ.

Bladder Campion.—I have taken from it *Noctua triangulum*, *Dianthœcia carpophaga* and *D. capsincola*, *Aplecta advena*, &c.

Reed.—From the blossoms of reeds have been captured specimens of *Orthosia lota* and *O. macilenta*, *Cerastis spadicea*, *Miselia oxyacanthæ*, *Nonagria lutosa*, *Xanthia cerago*, &c.

Barberry.—The golden blossoms are remarkably attractive to *Hadena dentina*.

Raspberry.—This is very attractive while it lasts, and is visited by *Aplecta advena*, &c. *Sesia tipuliformis* is greatly attracted.

Tansy.—An especial favourite with the genus *Plusia*.

Common Sage is very attractive in some seasons.

Pink is also an attractive flower.

Heather Bloom.—Very attractive.

The white tobacco flowers (*Nicotiana affinis*) are very attractive, especially to *S. convolvuli*.

In addition to this list, the following flowers and shrubs are attractive to moths, *viz.*, the French and African marigolds, the white verbena, sweet scabious, all the thistles, the common laurel, the snowberry plant, *gooseberry trees* when in flower, *syringa*, *ragwort*, *petunias*, and *privet*. I know of no shrub more attractive than syringa when in full blossom. It and the lime tree, under similar conditions, will, on favourable

nights and in favourable localities, absolutely swarm with insects.

A privet hedge in full bloom is a wonderful favourite, and should never be neglected. In the miserable summer of 1860 I was at Ringwood, in Hampshire. Just outside the town, bordering the high road, was a fine hedge of this kind. Whatever moths *were* out that summer came to the privet hedge, and nothing else. Sugar was of no use at all. It was interesting to watch with what unfailing regularity the moths, led by the appetizing odour, came sailing over the fields or the road, and settled down. Some do this at once, while others are restless and apparently fastidious, creeping from one flower to another till they find one to their liking. On this hedge I took two splendid specimens of *Triphæna subsequa.*

Petunias and *verbenas* seem to be the weak point in the characters of those rare and beautiful insects, *Deilephila galii*, *D. lineata*, and *Chœrocampa celerio.* Two of the most famous *natural* baits for moths are *sallows* and *ivy.* The sallows, when in bloom, must be examined with a lantern, or, if you have a companion, he may hold a sheet or umbrella under the tree while you shake it. The moths will fall helplessly down, and may be boxed at leisure. For my own part, I do not think sallows are to be compared with many of the shrubs already named. Very few insects are out at the time when sallows are in bloom. The greater part, nevertheless, of the genus *Tæniocampa* may be taken in this way. I do not at all deny that other species may be taken at sallows, but they are mostly autumnal species which have hybernated; consequently their appearance is not improved. It is, however, an important consideration that, in general, insects do not *pair* till *after* hybernation. Thus, *eggs* of many rare species are procured from these wasted females, as *croceago*, *rubiginea*, *petrificata*, and *conformis.* At least one specimen of that rarity *Cerastis erythrocephala* has been taken at sallow bloom. Next, as to "ivy bloom." An old wall or ruin, covered with ivy in full blossom, is as attractive to the collector of moths as to the moths themselves. Of all out-door methods of capturing insects, this is, to me, the most exciting, not excepting even "sugaring." My first introduction to "ivy bloom" was many years ago, at Almondsbury, near Bristol. Near the house in which I was staying were walls upon walls burdened with ivy, and laden with its fragrant blossoms. I had only one night at it, but it was a favourable night, and I shall never forget it. As the lantern was slowly passed along, first one and then another pair of eyes gleamed and shone in the light, like gems. *Phlogophora meticulosa* reigned supreme

in point of numbers; then there were *Calocampa vetusta* and *C. exoleta*, looking not unlike sausages; the delicate *Xylina semibrunnea* and *X. petrificata*, besides many common species *ad libitum*. To a beginner, as I then was, it was indeed a glorious and exciting spectacle. In addition to the two last-named, the great prizes at ivy bloom are *Camptogramma fluviata*, *Leucania vitellina*, *Hoporina croceago*, *Dasycampa rubiginea*, and some others. All the autumnal Noctuæ, and some Geometræ, frequent the ivy; and I think I may safely say that as an attraction it is unequalled; while in bloom, sugar is of scarcely any use if applied in its neighbourhood.

There are several ways of *capturing* insects at ivy. My own plan (when the ivy is within easy reach) is simply to examine it with a lantern in the left hand, while in the right I have the killing-bottle. If I see an insect I want, I get it into the bottle by placing it under the insect, and tilt it in. If, as will not unfrequently happen on ivy, the insect is sluggish, and won't be persuaded to drop into the bottle, I enclose both the insect and the spray on which it is feeding. When you expect insects to be plentiful, you should have *at least* two of these bottles with you. About every three minutes or so, if the insects are abundant and my bottles are getting full, I place the lantern on some convenient place (if I have a companion, he holds it), and then turn the moths out on to one side of my collecting-box. Selecting such as I may want, I pin them at once through the thorax, but under the wings, with a very fine pin, and stick them in the collecting-box. If any scruple be felt at leaving them alive and pinned, it may be obviated by killing them on the spot with the nicotine from a pipe-stem or with oxalic acid. For this purpose I carry in my waistcoat pocket a small well-stoppered bottle and a steel pen.

Another plan is "pill-boxing." If the collector be alone he has the lantern suspended round his neck. When an insect is seen he boxes it, holding the box in one hand, as described at p. 55. Both methods have their advantages and their drawbacks. The objection (which I readily allow) to my plan is that it takes up more time. Again, while it is not to be denied that time is taken up in turning out, pinning, and killing the insects, there is this counterbalancing satisfaction—you *know* that they can't be *spoiled*. Now, in pill-boxing it is allowed that *some* are almost sure to knock about, and so injure themselves. Consider also the feverish state in which you are kept, lest that "*rubiginea*" or that "*petrificata*" is spinning about in the pill-box! The state of the case, then, seems to be this:—By pill-boxing you obtain probably *more* insects, but with an increased risk of injury; by bottling, probably *fewer*,

but with the agreeable conviction that, such as they were when you bottled them, such they will remain. To save future repetition, I may observe that these remarks apply equally to "sugaring," of which I shall have to speak shortly. Generally, pill-boxing is limited to the Micro-Lepidoptera and the smaller Macro-Lepidoptera, unless indeed we are desirous to obtain eggs from some female of one or other species.

When the ivy is out of ordinary reach, another method, differing from either of these, must be had recourse to. I give an excellent and simple one, first shown to me by my much-esteemed friend, the late Mr. Birchall, than whom there was no more enthusiastic or indefatigable collector. The lantern, which should be a small one, is fixed on the top of a stick, three or four feet long, as the case may be. A *little* below the lantern is fastened a small bag-net, shaped so as to fit closely to a spray. With this implement in the left hand, you examine the ivy beyond reach. Whenever a desired moth meets your eye, all that is required is simply to *tip* it into the net with a stick held in the other hand. It can then be taken out of the net by one or other of the methods above. This will be found an almost indispensable instrument when the ivy is collected about trees, especially if they are in hedgerows.

One other plan must be adverted to, only, however, at once to condemn it. I mean that of *beating* the ivy. Nothing can be more suicidal. For the sake of one night's captures you irremediably destroy your preserves. It is the fable of the "Goose and the Golden Eggs." Let me therefore advise the beginner to have nothing to do with it. It would probably not do much harm to *shake* the ivy into an umbrella, provided it be not done too strongly.

When flowers are an attraction, it is a good plan to pick a bouquet of those most attractive, and fasten this to the top of a stick thrust into the ground, and so placed that the flowers stand well out against the sky-line. Insects are then easily noticed, even when it be too dark to see them when against the ground.

Honey-dew.—Whatever be the cause, on certain evenings throughout the summer and autumn, nettles, in ditches or waste places, will be found peopled with moths, attracted by the so-called "honey-dew" on the leaves. Whether this honey-dew be simply an exudation of the juices of the plant, or whether it be the dejecta of Aphides on the plants, appears to be undecided. It may, I conceive, sometimes be the latter, as it is well known that ants are busy attendants on Aphides. So far as I know at present, no entomologist has been bold enough to taste Aphides, as did a French *savant*, in regard of

the cuckoo-spittle, which he stated was decidedly sweet. A lantern is necessary. With this you examine the leaves, and on favourable nights the moths will be seen either crawling about, or imbibing the nectar, whatever that may be. Here the killing-bottle will be found invaluable. It is no joke, I fancy, "pill-boxing" a moth among nettles. It is difficult to avoid getting stung even in this case, but you are much less likely to be in this way than in the other, to say nothing of only *one* hand being endangered. In a small orchard, bordered by a quantity of nettles, close to my house at Brandeston, in Suffolk, I took myself, in one year, fine specimens of the following thirty-eight species:—*Epione vespertaria* and *E. apiciaria*, *Ellopia fasciaria*, *Acidalia imitaria*, *Timandra amataria*, *Cidaria psittacata* and *C. miata*, *Leucania conigera*, *L. lithargyria*, *L. comma*, *L. impura*, *Xylophasia hepatica*, *Apamea gemina*, *Miana strigilis*, *M. fasciuncula*, *M. furuncula*, *M. literosa* and *M. arcuosa*, *Agrotis suffusa*, *A. segetum*, *A. exclamationis* and *A. corticea*, *Noctua augur*, *N. c-nigrum*, *N. plecta*, *N. triangulum* and *N. festiva*, *Orthosia lota* and *O. macilenta*. *Anchocelis rufina* and *A. pistacina*, *Xanthia cerago* and *X. silago*, *Heliothis marginatus* (once), *Hypena rostralis* and *H. crassalis*, *Pyralis glaucinalis*. I have been thus particular about "nettles," as sufficient attention has not been paid to them. The above list will show how much may be done by those who don't mind a little stinging. There are not many "rarities" in the list, it is true; but beginners must "begin at the beginning." The honey-dew on sallows—especially in the Fens—is exceedingly attractive. On this, among other species, I have taken *Lithosia muscerda*, *deplana*, *griseola*, *stramineola*, *quadra*, *Epione apiciaria*, *Rumia cratægata*. *Boarmia repandata* and *rhomboidaria*, *Geometra papilionaria*, *Iodis lactearia*, *Hemithea thymiaria*, *Acidalia scutulata*, *bisetata*, *dilutaria*, *incanaria*, *immutata*, *imitaria*, *aversata*, *emarginata*, *Cabera pusaria* and *exanthemaria*, *Strenia clathrata*, *Abraxas grossulariata*, *Lomaspilis marginata*, *Larentia didymata* and *pectinitaria*, *Eupithecia centaureata*, *succenturiata*, *subfulvata*, *vulgata*, *minutata*, *tenuiata*, *Collix sparsata*, *Ypsipetes elutata*, *Melanthia rubiginata*, *Coremia ferrugata* and *unidentaria*, *Phibalapteryx lignata*, *Scotosia vetulata* and *rhamnata*, *Cidaria russata*, *testata*, *pyraliata*, *Pelurga comitata*, *C. duplaris*, *B. perla*, *Leucania lithargyria*, *obsoleta*, *pudorina*, *comma*, *straminea*, *impura*, *pallens*, *phragmitidis*, *Senta ulvæ*, *N. brevilinea*, *neurica*, *Axylia putris*, *Hydræcia micacea*, *C. graminis*, *Apamea unanimis*, *ophiogramma*, *fibrosa*, *oculea*, *Miana strigilis*, *fasciuncula*, *furuncula*, the *Caradrinas*, *Rusina tenebrosa*, *Agrotis corticea*, *nigricans*, *aquilina*, *Triphæna janthina*, *interjecta*, *orbona*, and *pronuba*, *Noctua plecta*, *c-nigrum*, *festiva*, *rubi*,

umbrosa, *baja*, *Epunda viminalis*, *Hadena chenopodii*, *oleracea*, *pisi*.

Sugaring.—We have considered most of the *natural* baits for attracting moths. Sugaring is an *artificial* substitute for them. I believe we owe the discovery of it, or at least its application, to the late Mr. Henry Doubleday. In writing this little work professedly for beginners, I am reminded of the time when I was myself one, and when I had the pleasure of first making his acquaintance. Though Mr. Doubleday can never read these pages, I cannot lose this opportunity of expressing my grateful remembrance of his kindness and generosity. As to his invariably courteous and gentlemanlike (adjective by no means to be applied to *all* naturalists) style of correspondence, his readiness to give to beginners the benefit of his great experience, and his liberal *gifts* of insects, I feel confident that, among those who have known him, there are not two opinions.

The strongest brown sugar, known as Jamaica, is boiled with old beer to the consistency of treacle, a small portion of rum * added and well mixed. The addition of certain essential oils has been recommended. Some use aniseed, essence of lemon, jargonel pear, essence of lemon-grass, essence of almonds, or other essences. I can speak highly of jargonel pear. The thickest black treacle, thinned by a little old beer and rum, sometimes answers as well as the boiled syrup above noted. The mixture is then laid on the trunks of trees, in favourable situations, with a painter's brush. It is better, I think, to make long, narrow streaks than broad patches. The sugar should be put on at dusk before the moths fly, choosing the side of the tree away from the wind, so that the moths will be sheltered while they feed. With a lantern suspended from the neck, thereby preserving an upright position during every movement, the collector may visit the trees several times during the evening. *Dicycla oo* and *Catocala sponsa* and *promissa* will come to sugar before sunset ; a lantern should even then be used—not that you may see them, but that the light may prevent their seeing you. On a good night, however, moths will come to any sweet mixture. A friend tells me that the best night he ever had in this way was when he used the "scum" from preserved fruit, when jam-making at his house

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* Experiments in which alternate trees were "sugared" with a mixture in which methylated spirit had been added, instead of rum, seemed to prove that the former spirit was more attractive than rum.

was going on. What constitutes a good night has yet to be discovered. As a rule, a cloudy warm night, with a little wind, perhaps fine rain, means a good night for sugaring. I have, however, known a night of this description to be an utter failure. On such a night (with lightning in the distance) I sugared in the New Forest, anticipating all sorts of good things, but scarcely a moth came to any of some one hundred or more trees I had sugared. On comparing notes the same night with a gentleman who had also sugared many trees in another part of the forest, I found his experience identical with my own. On the other hand, I have seen on a brilliant night, not too warm, with a full moon, swarms of moths on the sugar patches, although the moon was shining on them. Trees which have never been sugared before should have the mixture well worked into them, choosing trees with rough bark. Trees which have been recently repeatedly sugared will hold the sugar best, and will require less of it, besides more moths will probably come to them. One may sugar night after night in one place with little success, yet it may be well worth continuing the operation, so do not be disheartened if after two or three trials nothing much has come. Some fine night you may probably find good reason to have a high opinion of that place after all.

"The following method of sugaring has been found to answer well: instead of brushing the sugar on the bark of the trees, get some pieces of coarse rag, mix up your bait and steep them in it; let them remain till they are well saturated, when they may be pinned up wherever you wish, and when done with put them away for the next night. One batch of rags will last for a length of time, sugar being added when required. If reeds, when in flower, are cut and sugared, they can, when rolled in paper, be carried to any likely place for moths, and if stuck into hedges or holes in the ground (one sugared bloom at a time), they will prove very attractive, and can be collected and taken home for subsequent use. *Rotten* apples, when sliced and pinned to trees, appear to attract moths nearly as much as sugar." (Intell. ii. 45.)

Anything may be sugared—trees, palings, posts, leaves, flowers, and even walls. A favourable "sugaring" is an amusing as well as an exciting spectacle. The squabbles between *Xylophasia polyodon*, *X. lithoxylea*, *X. hepatica*, and *Triphæna pronuba*, for the possession of a choice "drop," are truly ludicrous. They push each other and tumble over one another till one, overcome with, I am sorry to say, "drink," falls helplessly to the ground, when his place is instantaneously taken by another. When the collector has obtained a good series of the above-named four insects, he will then begin to

find them an irritating pest, for they not only "shove" off the good ones, but make short work of the sugar, in which they are ably assisted by earwigs, slugs, &c., &c. I have found the body of an "Orange Underwing" filled to repletion with the composition. It is also truly interesting to watch a moth imbibing a drop of sugar. If a bold insect, he is in no way discomposed either by the light or your observation, but will go on sipping away, looking at you out of the corner of his bright eye, as if to say, "Ah! I am a common thing! I know you are not going to box *me!*" The rapidity with which a drop will disappear before a *Xylophasia polyodon* or a *Triphæna pronuba* is surprising. Some insects, as *Thyatira batis*, *T. derasa*, *Cymatophora ocularis*, *Catocala promissa* and *sponsa*, are very shy. Others, as *Xylophasia polyodon*, &c., come down with a "plop," and set to work at once. For *capturing* I must refer my readers to the directions already given under the head of "ivy bloom."

I do not think my account of sugaring would be complete without a list of at least some of the scarce insects that have been taken by it. In it will be found nearly all the newly-discovered species. It is to be observed also that some insects are usually *only* taken at sugar, as *Catocala promissa* and *C. sponsa*, commonly known among the habitués of the New Forest as the "Crimsons." The following species, new to Britain, were discovered by means of sugar, or, if not actually *discovered*, taken almost exclusively by its means, *viz.*, *Leucania vitellina*, *L. extranea* and *L. putrescens*, *Nonagria concolor* and *N. elymi*, *Agrotis ashworthii*, *Noctua sobrina*, *Cerastis erythrocephala*, *Phlogophora empyrea*, and *Hadena peregrina*.

Among the species which were very rare, and have been made *comparatively* common by sugar, the following are especially worthy of notice:—*Cymatophora ocularis*, *Diphthera orion*, *Leucania obsoleta* and *L. straminea*, *N. brevilinea*, *N. neurica* and *N. hellmanni*, *Laphygma exigua*, *Heliophobus hispida*, *Mamestra abjecta*, *Agrotis lunigera* and *A. ripæ*, *Triphæna subsequa*, *Noctua ditrapezium* and *N. subrosea*, *Euperia fulvago*, and *H. rectilinea*, *Plusia orichalcea*, *P. leucophæa*.

Besides these, multitudes of the commoner species are taken at sugar, and on the whole it must be acknowledged as the best way of obtaining Noctuæ. The beginner, however, must not be surprised at finding many "barren" nights, not to mention wasted specimens, some of which, however, may be boxed for eggs.*

* In these days, when "golden syrup" has superseded the old-fashioned black treacle, the addition of a little glucose will stiffen the sugaring mixture.

Taking Lepidoptera at Light.—Gas-lamps have long been usefully searched, and suggestions have been made as to working lighthouses. It is only of recent years that light has been systematically worked by many people. On certain nights, particularly those that are hot and dark, accompanied by a drizzling rain, moths will come to light in vast numbers. The following quotation from a communication by Mr. Wheeler gives a good idea of the attraction of light; he refers to a lantern similar to that described in the next page and placed in the Cambridge fens:—"Two nights in particular, July 10th and 11th, the weather being just perfect, *viz.*, oppressively close, and the sky black with clouds, from which thunder, and at intervals a drop or two of rain descended, were to me times never to be forgotten. Standing beneath the lamp, its rays made a circle of light amidst the surrounding blackness, and this circle was apparently closed in with a hovering cloud of moths. I am sure I do not exaggerate when I say they were in tens of thousands; to select under such circumstances was impossible, and every dash of the net among the swarms that from time to time came close up to the light produced a mingled assemblage of captures that made boxing a difficult matter, for often two or three would crowd into the pill-box. Sometimes this was varied by the sudden bang of *M. arundinis* against the glass, followed by a buzzing as it fell among the grass and rushes, or the noisy dashing about of *G. quercifolia*; but the *tout ensemble* produced an impression the very recollection of which calls up a thrill of excitement."

Flat open country has been most profitably worked by light in this way, but, doubtless, on suitable nights, open parts of woods and their outskirts would well repay the collector. At light I have captured the following species:—*Smerinthus populi*, *S. ocellatus*, *Sphinx ligustri*, *Chærocampa elpenor*, *Macrogaster arundinis*, *Nudaria senex*, *Lithosia griseola*, *L. deplana*, *Chelonia caja*, *C. villica*, *Arctia fuliginosa*, *A. lubricipeda*, *A. menthastri*, *A. urticæ*, *Odonestis potatoria*, *Lasiocampa quercifolia*, *Saturnia carpini*, *Eurymene dolabraria*, *Epione apiciaria*, *Crocallis elinguaria*, *Hemithea thymiaria*, *Acidalia immutata*, *Strenia clathrata*, *Lomaspilis marginata*, *Emmelesia affinitata*, *E. alchemillata*, *E. decolorata*, *Eupithecia venosata*, *linariata*, *centaureata*, *succenturiata*, *subfulvata*, *subumbrata*, *pygmeata*, *castigata*, *subnotata*, *vulgata*, *minutata*, *absynthiata*, *assimilata*, *tenuiata*, *exiguata*, *pumilata* and *rectangulata*, *Phibalapteryx lignata*, *Scotosia rhamnata*, *S. vetulata*, *Cidaria sagittata*, *russata*, *immanata*, *testata*, *pyraliata*, *Pelurga comitata*, *Cilix spinula*, *Dicranura bifida* and *vinula*, *Clostera reclusa*, *Ptilodontis palpina*, *Notodonta ziczac*, *N. dictæa*, *Bryophila perla*, *Simyra venosa*, *Leucania conigera*, *lithargyria*, *pudorina*,

straminea, *phragmitidis*, *pallens*, *impura*, *Meliana flammea*, *Senta ulvæ*, *Nonagria brevilinea*, *Axylia putris*, *Neuria saponariæ*, *Mamestra anceps*, *M. albicolon*, *Apamea basilinea*, *gemina*, *unanimis*, *Hydrilla palustris*, the *Caradrinas*, *Epunda viminalis*, *Hadena atriplicis*, *thalassina*, *pisi*. *Bankia argentula*, *Hydrelia unca*, *Cucullia umbratica*, *Plusia festucæ*, *gamma*, *iota*, *Nascia cilialis*, and many others. The following is a description of the lamp:—A case 20 inches high, 15 inches square, having glass on three sides; the top of perforated zinc; door lined by bright tin or a looking-glass to act as reflector. Through centre of case passes from top to bottom a circular tin tube, three inches in diameter. This tube allows the pole on which the lamp is raised, to go through, and prevents it being charred. Round the tin tube at bottom of case have a circular piece of wood fitting easily. On this fix, at equal distances, four small paraffin lamps, each lamp having a glass chimney. These lamps can be brought (as the woodwork will revolve) in rotation to the door for filling and cleaning. A rather more expensive, but handier, arrangement is to have the reservoir for the paraffin made of zinc, like a large flat ring, which goes over the tin tube before it is fixed to the top of the case. Four wick and chimney holders are screwed into this reservoir, which can be turned round the tube. The lantern is placed on the ground, the pole (some eight or nine feet high) passed through the tube and pressed into the ground, and the lantern raised to the required distance, and kept in its place by a brad-awl stuck under it into the pole. A square piece of tin hinged, so as to fold flat, but with an aperture in the centre to allow for the pole, can be placed like a roof over the lantern to keep out rain. You take your stand in the shadow of the door, and can then net insects coming to the light. It is a bad plan to rush out at them, but allow them to come well up. On windy nights a sheet some six feet high and nine feet long, supported by three sticks, should be put so as to have the lantern out of the wind. If a portion of the light be thrown on to the sheet many insects will come and settle on it. All this may seem a troublesome arrangement, but consider the rarities which have been taken at it.

Before we go "indoors," there is one other point to be considered. As my readers have been reflecting upon the various methods detailed above of capturing insects, the question has probably occurred to them, "How am I to carry them home?" I have already mentioned one way in which this is frequently done, *viz.*, putting the insects alive into pill-boxes, and carrying them in the pocket. My own plan is to pin and kill them at once, and then put them into a "collecting-box," which I proceed now to describe. "I made

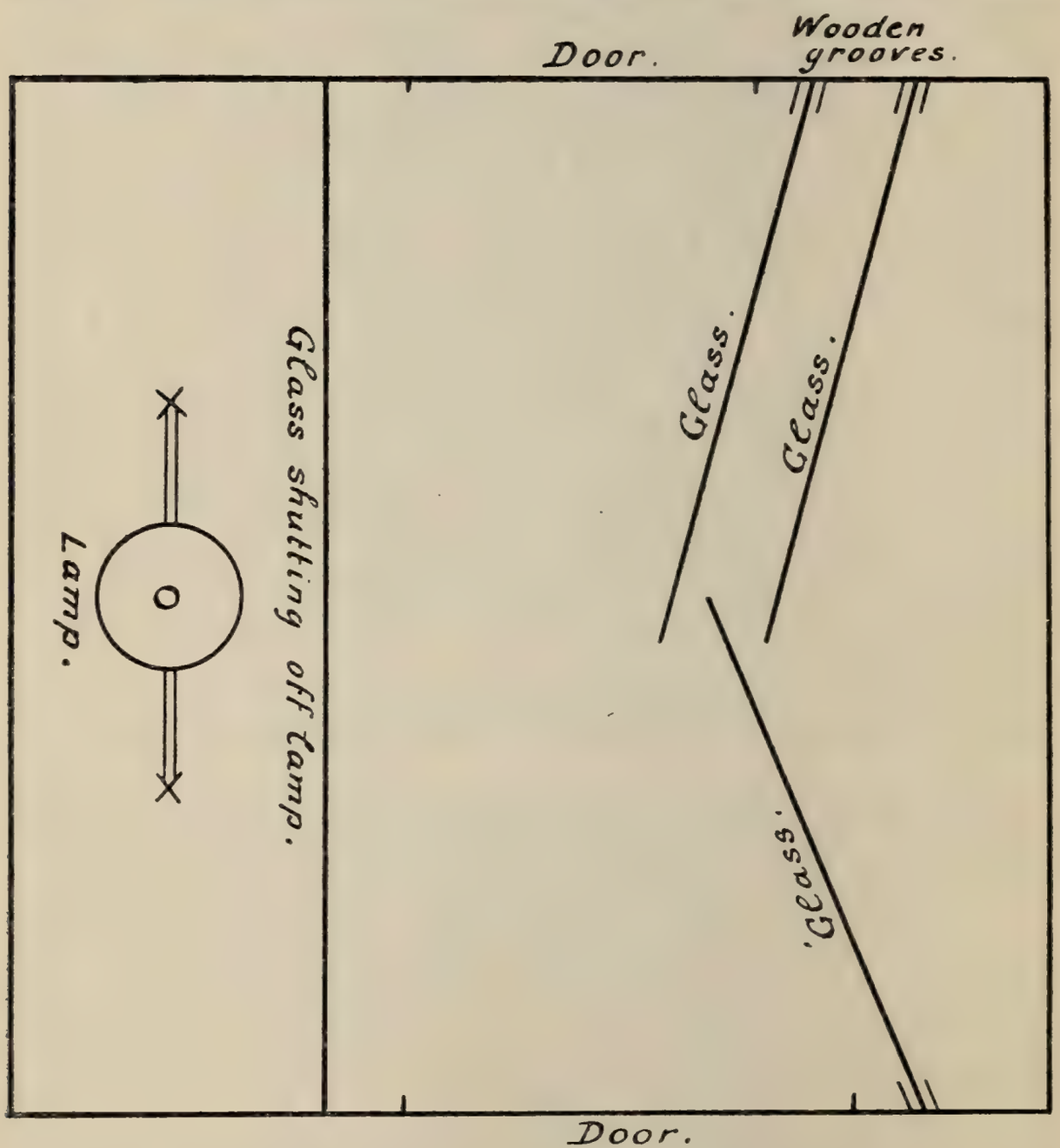
a small japanned tin box, about nine inches long, six inches wide, and one and three-quarters deep. By having the box *double* this depth, both sides might be corked, which would be a great advantage, as enabling the collector, without any inconvenience to himself, to bring home double the number of insects. In the bottom of this tin box I put a thin sheet of cork, securing it by means of several tin points projecting from the sides. I then filled the box with warm water, and let it stand several hours, until the cork was well saturated with moisture, when, the superfluous water being poured off, the box was ready for use. Under the *bottom*, and also upon the *hinge* side, are two tin loops, through which, when I reach the hunting-ground, I put two straps: one of these I pass round my neck, and the other round my waist, thus securing the box upon my breast, with the lid opening from below. Here fixed, it leaves both my hands at perfect liberty, and does not cause any impediment to swift pursuit of insects on the wing. In this box, and after a long day's chase in the hottest weather, I have never failed to bring home the smallest moth through which a fine pin could be passed, as flexible as if just killed; in fact, I have frequently kept moths perfectly pliant in this box, until they have been covered with a fine flourishing crop of fungi. I have also a smaller box, made on the same principle, to put into my pocket when taking only a short walk. When not in use I keep water standing in them, so as constantly to have them ready for the chase. This kind of box is by far the best, for relaxing dried specimens of insects, of any I have tried; and for this purpose, as well as that for which I had it at first constructed, I cannot sufficiently recommend it to the notice of entomologists." (Zool. 1843, p. 177.)

Zinc pocket-boxes, permitting the cork-lining to be damped, may be obtained of any dealer in entomological apparatus.

Moth Trap.—A moth trap, which has been in use some few years and in which over seven hundred species of Lepidoptera (not including Micros) have been taken, may be thus described:—

It is some five feet six inches square, with a perforated zinc door at the back. Inside the door is a shelf on which to raise the lamp, and then, fourteen inches from door, is a sheet of glass shutting off the lamp from the rest of the trap. The arrangement in front of this sheet of glass is a door two feet wide on either side, and opening backwards, so as to take specimens from the glass sheet before the lamp and elsewhere. The front of the trap is open, and there are three sheets of glass, two feet three inches wide, stretching from top to bottom, and inclining inwards and overlapping one another (two on one

side, one on the other) "herring-bone" fashion, but with space to allow moths to pass between them. The top inside is flat, and the whole is covered by a sloping roof, projecting all round to carry off rain, and having an aperture at the top to carry off the heat from the light, but protected from admitting wet by a raised sloping cover. The light used recently is acetylene, generated in a special vessel outside the trap, the gas being conducted to an upright branched standard by a rubber tube passing through a small aperture at the bottom of the door. The branched light has two burners, over which are open-ended cones to convey the heat into the roof and thence through ventilating cover. The woodwork inside is painted white. The following illustrations give a fair idea of the trap.



~ GROUND PLAN ~

Fig. 11.

Sometimes only two sheets of glass in front are used in moth-traps, one stretching from side to side inclining inwards, rather more than half the height of the trap, and another coming from the roof, also inclining inwards, and almost touching the other, leaving room only for a moth to crawl between. In this arrangement the moth has to crawl up the lower glass to get in, and I have noticed that moths have often flown away after crawling a little distance up the sloping glass, but not sufficiently far to be prevented by the descending glass sheet.

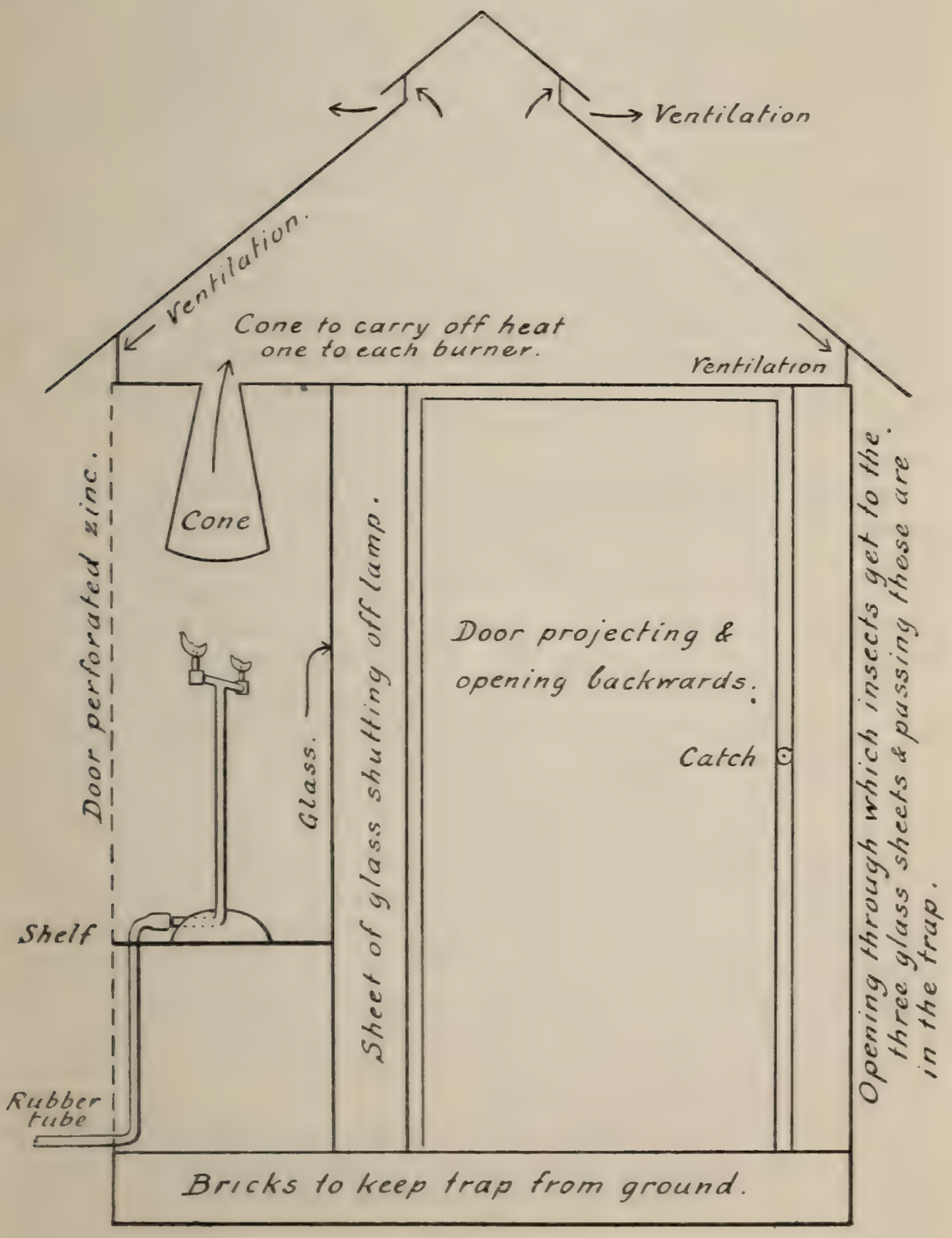


Fig. 12.

If a trap such as I have described is worked systematically year after year, one meets with many surprises. Each year adds to the list of species taken. Then, again, a species will be common one year and scarce, or even absent, the next. A species may appear on one year and not again for several succeeding years. *Heliophobus popularis* was in swarms one year, but only occasional specimens, few in number, on many other years. *Luperina cespitis* appeared during one year only, and, curiously enough, only females. One year the "new insect" was one *Cucullia gnaphalii*, another year it was a specimen of *Boletobia fuliginaria*. Then *Agrotis cinerea* was added to the list. It was some six or seven years before *Camptogramma fluviata* put in an appearance, and then for a year or two it was fairly common. *Agrotis puta* is constantly double-brooded, as demonstrated by this trap. Without exaggeration, simply hundreds of moths would, on some nights, be attracted—in fact, far too many—as, upon opening a door to secure a specimen noted from the outside, such a number would be disturbed that it was almost impossible to detect the desired specimen, whilst the rustle of the moving wings was quite audible. This trap was placed on the edge of a cliff some eighty feet high, and so commanded a considerable area.

Indoor Light.—When the collector has folded up his net, taken his last round of the sugared trees, and returned home with, let us hope, full boxes, there still remains one method of capturing insects, less productive, but certainly not less exciting, than any of the preceding, *viz.*, that of attracting them into your room by *light*. I only find one correspondent of the 'Zoologist' who describes the apparatus he employs for this purpose:—"My attracting apparatus consists of three gas-lights, with fifteen-hole argand burners, One of these is affixed to the outside of a balcony, at an altitude of twenty feet from the ground, and protected by a lantern (somewhat like a gas-lamp) which has a reflector at the back; in the room which opens on to this balcony is another light, which is kept within about two inches of the window; this also has a reflector behind it; the third is in the room below the balcony. I consider it very essential there should be a light outside the building, since one inside a room has but a confined sphere of action compared with one completely outside."—(H. T. Stainton, Zool. 1848, p. 2030.)

This is an exceedingly costly, and, to most collectors, a wholly impracticable *illumination*. Now that electric lighting is so general, moths in large numbers may be enticed into

sitting-rooms by this means, especially if the light is arranged so that the outside is freely illuminated.

Two composite candles, or a lamp placed on a small table near a window, answer sufficiently well. If there be two windows in the room (which should be an upper one), I place a candle at each. On the little table are the following requisites, *viz.*, one or two corked collecting-boxes, a little tray full of fine pins, a small bottle with a saturated solution of oxalic acid, a steel pen, and one or two killing bottles. Close at hand, ready for instant use, must be the bag-net. On very still nights the window may be opened both at the top and the bottom. I raise the lower part of the window, however, not more than a foot. I then sit down with a book, outwardly calm and collected, but inwardly full of excitement and expectation, and—WAIT! While doing so I will make a little digression.

It is a curious circumstance that there seems to be an interval, *viz.*, from a little after nine to about half-past ten, during which moths appear to cease *flying*. Whether it be that they are undergoing the process of digestion, love-making, or recruiting their energies, I know not; but the fact, at least in my experience, remains. From half-past eight to about half-past nine they may be seen flying over and about the flowers, shrubs, &c., attractive to them; but at the end of that time they almost entirely disappear. When this has been the case I have returned home and tried the light at once, but in vain. This I have done over and over again. I have repeatedly sat at the open window for an hour or an hour and a half without seeing a single moth.

And now to return. From what I have just said it will appear that there is not much use in trying to attract moths by light before eleven o'clock.

Well! I am reading an intensely interesting chapter, when suddenly one or other of the three following incidents takes place. I hear a fluttering (which produces a corresponding fluttering on my part) on the ceiling; or a sudden and startling tap on the window; or something glides past me, and drops gently and softly on the book itself, where it settles itself, with the apparent intention of going to sleep,—sad emblem of that sleep which is shortly to be for ever! In the first of these cases I look up, and lo! a large brown moth careering wildly against the ceiling. In an instant the net is grasped, and then begins a frantic chase to capture it, a matter by no means so easily or speedily accomplished as at first sight might be thought. The ceiling is *scraped*, with no result but that of a quantity of whitewash falling into your eyes. Then the moth, alarmed, quits the ceiling, and flies about the room with a deep (and oh! what a pleasant sound it is) hum.

The net is whirled backwards and forwards, upwards and downwards, till at length a fortunate sweep—and he is in. I then hold the net up against the light, and speedily bottle him. In the second case I look at the window, and there, peering at me through the glass, with his gleaming eyes, sits another moth. The bottle is seized, and the arm put outside with the box in the hand. It is cautiously and gently moved up. It touches him! There is a skip backwards, and in a moment he is secured. In the third instance the moth, if it remains quiet, is skilfully impaled at once and killed. If, however, I see that ominous quivering of the wings which betokens immediate flight, I bottle him. The *book* is now cast aside, and, as the insects come tapping at the window or flying into the room, hands, arms, legs, and eyes are fully occupied. Some make known their presence at the window by a loud and indignant tap, and the noise made by a large moth, as *Arctia caja* or *Smerinthus populi*, coming full bang at the glass about one or two o'clock in the morning in a retired country place, where everything is as still and silent as the grave, is no joke to the already sufficiently excited nerves. Others alight quite gently, and lie with extended wings against the glass, as the various species of the pretty genus *Eupithecia* and many of the Geometræ. Others will crawl in, and, fixing themselves on the inside of the pane, remain quite motionless all night, as *Cilex spinula*. Others will betray their presence by a loud humming in the room. It is difficult, till you have actually experienced it, to understand the emotion produced by this sound. Others again will, unfortunately, dash fiercely in, and make straight for the light. This is the only way, so far as I know (which presents a reasonable prospect of success), of capturing Bombyces in the perfect state. These are in general the most noisy and obstreperous, especially the males. Conspicuous for its frantic gyrations is *Bombyx neustria*. It is almost impossible to capture it. It will fly into your face, down your coat-sleeve, into the light, anywhere in fact except into the net, which it seems to avoid as if by magic. It is curious to note the effect produced upon this violent and excitable little creature by the action of the cyanide. In half a minute it will drop to the bottom of the box, utterly prostrate and helpless. The contrast between its late frantic exertions and its present death-like repose is sometimes almost ludicrous. Though I have said that "light" seems to be the best way of attracting Bombyces in the perfect state, yet I do not think *much* is to be done. The following are the best insects I have taken in that Order by this method, *viz.*, *Lithosia aureola*, *L. griseola*, *L. stramineola* and *L. quadra*, *Arctia fuliginosa*, *Demas coryli*, *Dicranura furcula* and *D. bifida*, *Ptilodontis*

palpina, *Notodonta camelina* and *N. dictæa*. Most of these I have only taken rarely, however. There is one moth, nevertheless, which is a true pest at night. I mean *Arctia menthastri*. I have seen at least fifty in the room at one time. It is impossible to get rid of them. You have no sooner thrown one out of the window than it instantly returns in company with half a dozen more ; nor is it an uncommon occurrence if you use a candle to have it extinguished three or four times in the course of the evening by their unwearied efforts at self-immolation.

The *time of year* at which to commence this employment of light is about the end of June, and it may be profitably used to the middle or end of August. During that period multitudes of Noctuæ and Geometræ may be taken, and among them some that are by no means common. The following comparatively rare or local species I have myself taken at different times and places :—*Acronycta aceris*, *Apamea connexa*, *Xylophasia sublustris*, *Neuria saponariæ*, *Heliophobus popularis*, *Cerigo cytherea*, *Luperina cespitis*, *Mamestra anceps* and *M. furva*, *Miana arcuosa*, *Caradrina morpheus*, *Agrotis corticea*, *Noctua augur*, *Orthosia macilenta*, *Dianthœcia carpophaga*, *Aplecta advena*, *Hadena adusta* and *H. contigua*, *Pericallia syringaria*, *Ennomos lunaria*, *Corycia temerata*, *Numeria pulveraria*, *Eupithecia sobrinaria*, *E. subfulvaria*, *E. centaurearia*, &c., and *Emmelesia bifasciata*. The best insect, however, which I ever took at light, indeed one of the best insects I ever took in any way, was *Agrotis cinerea*. I captured seven specimens in one night. Unfortunately it is one of those species which has a *penchant* for the candle, and, with the exception of two, they were consequently more or less injured. About one o'clock in the morning the collector's room presents a truly curious, not to say formidable, appearance. It literally *swarms* with insects. I say *insects*, for almost every Order is represented. There are gnats, flies, beetles, bugs, fleas, centipedes, ichneumons, midges, spiders of every size and shape, earwigs, &c., &c. One feels at times almost bewildered. What with the ceaseless hum of insect life, half a dozen moths perhaps on the window, another half-dozen apparently knocking out their brains against the ceiling or careering through the room, whilst others are whirling about in dangerous proximity to the light, the collector is often at his wit's end. But this renders it only the more interesting, and it certainly is to me the most exciting and delightful way of capturing insects.

On favourable nights the moths will begin to appear a little before eleven, and will continue to do so, in gradually increasing numbers, till two or even three in the morning—in fact, till daybreak. As to what *are* favourable nights, it seems as

difficult to lay down any fixed rnles for light as for any other method of attracting. Damp, mild, sultry and dark nights, without wind, are generally the best. I have found that just before and just after a thunderstorm is a period at which moths are almost sure to be abundant. A nearly invariable prognostic of good nights is the assembling of numbers of small midges on the window-panes soon after the light is exhibited. They are the almost certain forerunners of Lepidoptera. In this, as in every other method of capturing insects, much patience and perseverance are essential to success. On some nights moths will swarm, on others very few come, perhaps none at all. If there be the least frostiness in the air the case is hopeless. But there is one great advantage in "light" which is also peculiar to it: you can read, or otherwise employ yourself, when insects are few and far between. The collector, supposing him to commence at half-past ten, must not be disappointed if he does not see a moth for the first half-hour, or even hour. If, however, nothing comes by twelve o'clock, I regard it as a bad job.

In connection with light, I may add that it is a good plan (especially by way of a little variety) to lean out of the window (the candles being placed behind you) with the bag-net. Not unfrequently you will see moths sailing up towards the light, and may catch them in the net before they enter the room. One advantage of this method is that many moths come only to take a look, as it were, at the light, and then fly off again. I cannot explain this, but know it to be truly tantalizing.

One other remark. It is well known that, as a rule, on *moonlight* nights moths forsake sugar, ivy, flowers, &c., and wholly disappear. The same is true of light. When the moon comes out it is a signal for all properly disposed moths to go to bed, and the best thing for a collector is to do the same.*

One thing should be borne in mind, namely, that many of the so-called rarities are rare only in collections, because our knowledge of their *modus vivendi* is very small. When, therefore, you have taken a rarity, do not put it all down to luck and think there are no more to be had, but take into consideration all the circumstances under which the capture was effected. Look about for the food-plant of the larva (if you know it), and if you find it the chances are in favour of your getting more of your rarity either sitting on the plant or flying round it. Was your first capture a male, and was it hovering

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* The so-called "American Moth Trap" appears, from various communications addressed to the 'Entomologist,' to be, what I always supposed it would be, a "humbug."

at all? If so, there is a chance of there being a female near which had attracted it. I once took seven males of *N. brevilinea* in this way. Note the direction in which the insect was flying; in fact, bring all your powers of observation to bear on the question, and you may succeed in proving that many specimens of your "rarity" may be obtained.

Grouting! is a term that has been applied, by a most energetic exponent of the art, to a mode of collecting which has been most successfully followed — especially for collecting Micro-Lepidoptera — in the Fens. The collector slowly burrows on his hands and knees through the tall sedge, and boxes the moths which, frightened by the proceeding, crawl up the stems from the roots where they have been resting. The knees may be protected by leather pads similar to those worn by riflemen when firing. No other mode of collecting, perhaps, more astonishes lookers-on who are not in the secret, or is more productive of fatigue to the collector; but on windy days, when nothing else is to be done in the Fens, many a good insect may be obtained. Does my grouting friend remember the exquisite *Nascia cilialis* he captured in this way?

Smoking. — A fumigating apparatus, such as is used in greenhouses or for smoking beehives, may be usefully employed in the daytime to dislodge insects hiding in thick, low bushes, or in herbage, heather, reed-beds, &c. Two collectors working in concert is the best arrangement, one doing the smoking, the other the netting, of the insects. Many an insect, too, which may be marked down into long grass, may be induced to put in an appearance again by a whiff or two of tobacco-smoke being sent into its hiding-place. By this means good insects have been turned out from reed-stacks and captured. "The pipe that soothes" is an acquisition therefore to the entomologist, as not only may we dislodge insects by the smoke, but kill them by pricking them with a pin smeared with the nicotine from the pipe-stem.

Killing.—I proceed now to the question of "killing." There are few points on which so great a difference of opinion exists among entomologists as this. Some years ago there was a controversy carried on in the pages of the 'Zoologist' on the question of the amount of pain which insects were capable of feeling. It is not, of course, my intention to enter into that controversy here. I shall only say that I have long since convinced *my own* mind that insects feel *pain* (in the common acceptation of the term) in only the slightest possible degree. But, while holding this opinion, I am equally satisfied that,

from whatever point of view we regard the question of feeling or not feeling, we shall be on the *safe* and *humane* side in employing the speediest and most efficacious method of destroying life. The most usual method employed by different entomologists for this purpose is the killing-bottle before described, but some entomologists who pill-box their captures use ammonia as a means of killing. The lids of the pill-boxes are moved slightly sideways, so as to admit the fumes of the ammonia through a small crevice. The boxes are then arranged round a small saucer placed in the bottom of a basin. Into this saucer a little of the strongest liquid ammonia is poured, and the basin instantly covered over by a cloth, and a board placed over that. The boxes, if the captures have been made at night, are left till morning. The insects will then be found dead, perfectly relaxed, but they should be allowed to remain exposed for some little time to permit the ammonia quite to evaporate, otherwise the pins may be affected and become brittle. The boxes, too, should be well aired, so that the next batch of insects for which they may be used may not be incommoded by any trace of the ammonia, which would cause them to flutter about in the boxes to the detriment of their appearance. The green colours are affected by ammonia. The ammonia must be kept in a *tightly stoppered bottle*, as in hot weather it is very restless, and does its best to drive the stopper out. When travelling tie a piece of wash-leather over the stopper, unless you wish your clothes to be saturated. If the lid of a pill-box has a perforation made by a pin, and a drop or two of chloroform be dropped on it, an insect inside the box will quickly be stupified and need not become rigid.

Relaxing, &c.—Insects, if it be not convenient to set them at once, may be kept for a little time in a zinc box lined with cork, over which has been poured boiling water. The water is poured off, and some of the remaining moisture removed by blotting-paper, and the *dead* insects are then pinned in. The box should be rinsed out with boiling water from time to time, not only to keep it sweet, but to prevent the growth of "mould." A few drops of carbolic acid with the boiling water prevents the growth of mould. Bruised young laurel leaves will also keep insects relaxed for a long time, if they be in a jar having a tightly fitting cover. Damp sand (with a drop or two of carbolic acid), and covered by a tumbler or bell-glass may be used for relaxing. Insects which have dried may by these methods be relaxed so as to set them properly.

Setting.—An insect, however fine, however perfect it may be, is irretrievably spoiled by bad setting. I take this as a

postulate. The following are the chief particulars which constitute *bad* setting:—an unsuitable pin, being too large or too small; the pin being badly inserted, *i. e.*, leaning forwards, backwards, or sideways; the wings being too much or not sufficiently pushed forwards; the wings on one side being higher or lower than those on the other; the antennæ and legs not arranged but left to shift for themselves; and the body not being properly "laid out," if I may use the expression. I must say I rarely see what I call a well-set insect; that is, I rarely see an insect which, when set, is not open to the charge of failing in one or more of these respects. Before I go any further in this matter, let me *urge* upon my young readers, in the strongest manner, the duty of trying to master "good setting." I do not for one moment insinuate that it is an *easy* matter, because it is *not* so. I am also quite ready to allow that some will never attain to such excellence in it as others; but surely this is no reason for not trying at all? I am sorry to say that,

Fig. 13.

judging from the insects I have received, I am compelled to come to the conclusion that the *majority* of collectors pay little or no heed to good setting. The pin seems to be thrust haphazard into the insect—one wing up and another down; the legs invisible; the antennæ stretched out straight and stark from the head; or laid on the wings so as to be lost sight of; while the body looks one way and the head another. But it may be objected to me here, "What *you* think *good* setting another may think bad or indifferent, or *vice versa*." Unquestionably. But there is some setting which all candid and impartial persons must at once pronounce to be *bad*. Probably every collector will, more or less decisively, have his own idea as to what *good* setting is; and it is equally probable that he will consider every other method inferior to it. I at once plead guilty to this charge in my own case, and cannot therefore blame any one who may differ from me. At the same time,

however, it will not, I think, be denied by any that an insect set in the manner I have just described is not *well* set. The grand questions, then, to be answered are:—First, "When *is* an insect well set?" and secondly, this being settled, "How is it done?" The accompanying figure (Fig. 13) will answer the first of these questions in my judgment. The second I shall now endeavour to answer, observing, however, that I do not speak here of the Micro-Lepidoptera. To any one or more, then, of my readers who may agree with me in thinking that the accompanying woodcut represents a *well*-set insect, and who may desire to know the *modus operandi*, I give the following directions, which I hope may be intelligible.

Procure half a dozen boards of *soft* deal (or, better still, corked setting boards), a foot, or a little more if you like, in length. The *breadth* of the different boards must vary accord-

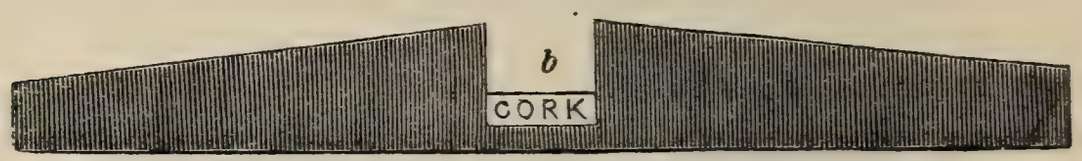

Fig. 14.

Fig. 15.

ing to the size of the insects which are to be set on them. The *largest*, for such insects as *Acherontia atropos* or *Sphinx ligustri*, should not be less than six and a half inches. The *smallest*, for the insects comprised in the genus *Acidalia*, &c., may be one inch. In the centre make a *groove* (Fig. 14, *b*). The depth and width of this groove must obviously vary according to the size of the insect. For ordinary-sized Noctuæ the depth should be *half* an inch, and the width *three-eighths*. On the bottom of this groove glue a thin layer of cork (Fig. 15, *c*), a little more than one-eighth of an inch in thickness. Commencing, then, at the edge of the groove, plane each side of the board until it assumes the form of Fig. 14* taking the

* Or, if preferred, Fig. 15.

utmost care that each side corresponds in the amount of deflexion. This is all that is required for the setting-*board*. As I have already said, the depth and width of the groove will vary according to the size of the insect. This variation the collector will soon be able to decide for himself, observing always that it must be *wide* enough freely to admit the body of the insect, and *deep* enough to leave a *small* space between the board and the wings when the pin is thrust *through* the cork. But while the *grooves* must thus vary, it is quite different with regard to the *slope* of the boards. The *degree* of slope must be left to the fancy of each collector, but, having *once* settled it, it must be the same in *all* the boards. But corked setting-boards, which I think are best, may be obtained of any dealer in apparatus.

The first, and perhaps the most difficult, part of good setting is to *pin an insect well*.

I had perhaps better make a little digression here about the proper pins. There are pins manufactured expressly for entomological purposes. These pins may be obtained of most respectable naturalists, who will forward a pattern paper with all the varieties of pins in use by entomologists: to each of these is attached a number, and the price per ounce. Black pins, however, are to be preferred. See p. 82 ("Grease").

I *recommend* (nothing more) for the very large Sphingidæ, No. 12; for the large Sphingidæ and Bombyces, No. 13; for the Rhopalocera, the middle-sized Sphingidæ and Bombyces, all the Noctuæ, with very few exceptions, and the large Geometræ, No. 8; for middle-sized Pyrales and Geometræ, No. 7; and for the small species, whenever they occur in the above-named Orders, No. 10.

Suppose now you have a specimen of *Notodonta dictæa* to pin: take a No. 8 pin, and holding the moth underneath with the first finger and thumb of the left hand, *press up* the wings till their apices nearly touch over the back; insert the pin exactly in the centre of the thorax, and the point should come out between the second and third pairs of legs. The head of the pin must slope a very little forwards towards the *head* of the insect. This will not be noticed when the moth is set. The pin should be clear of the moth on the *under* side, three-eighths of an inch. It is of *great* importance that the pin (the upper part of course) should not lean to either side. This constitutes the great difficulty in good pinning. To obviate this I hold the moth by the pin on the under side, and, keeping it steadily before my eyes, judge of the position of the pin. Practice alone can make perfect in this matter. It is also a good plan to pin the moth into the groove, and push it down till the wings rest on the board. You can then judge

tolerably accurately as to whether the pin is straight or not. Before proceeding, however, to arrange the wings, the insect must be raised a *little*, so as to leave a *slight* space between them and the board. Have ready pinned some "braces" formed of strips of smoothly-cut quill pinned with the smooth-rounded surface downwards, or of cardboard, if quills are not accessible; some strips of smooth tracing-paper, regulating the size in proportion to the moth, and some common pins. Having the moth situated in the groove, the *left* upper wing is to be pushed up to the required height (this depending on the fancy of the setter), by means of a pin or needle placed underneath it, and the under wing is also pushed up. Take a quill, or cardboard, brace and pin it so as to hold the wings firmly near to the base. Pursue the same method with the other side The advantage of having the wings thus held is to enable you to see whether the wings on each side are at the same angle with the body—a condition inseparable from good setting. When this has been arranged to your satisfaction, take a piece of the tracing-paper and pin it over the wing. The chief difficulty which the beginner will have to encounter is the *pushing up* the wings—I mean without injuring them. This can only be overcome by constant and regular practice. It is also to be observed that the same difficulty must be met, whatever be the method of setting. Another way, and a very good one, is to obtain the very long flexible needles, such as are used for threading small beads, and make a knob at the eyed end with sealing-wax. These are used for holding the wings in place while covering with tracing-paper. Having pinned the specimen to be set in the groove of the setting-board, insert the point of the needle in the cork in front of the base of the wings on the right; then depress the needle (parallel with the groove) from the waxed end with the left hand, ready to press the wings down when arranged in position by a pin with the right hand. A little practice will teach the amount of pressure required to make the needle hold the wings in position without injuring them. Then cover the wings with a piece of tracing-paper the required size and pin down firmly. The wings on the left side are then got into position in the same way, but reversing the use of the hands. If the body of the insect is not dry on the pins it will be inclined to shift to one side, but a pin placed on each side of the base of the thorax will obviate this. Care should always be taken to have uniformity in the length of pin protruding underneath the bodies.

If the groove be so deep that the *body* of the insect will *sink* unless it be supported, take two pins. It is also a good plan to have a *third* pin inserted at the extremity of the anus. The

first pair of legs should be lifted up from the groove, placed on the board and, with the antennæ, fixed by pins, also the hind pair of legs. The *antennæ* should be placed so as to be kept in place by the tracing-paper.

The boards should be kept in a dry clean place, and carefully guarded from dust. The insects should be examined every morning, to see if the wings, antennæ, &c., have slipped. This must be done till the insect has stiffened.

Some people, however, set Lepidoptera in the following way:—Use short wooden setting-boards of some four to six inches in length, having corked grooves. In the wood at each end make some cuts with a penknife. Having pinned the insects in the corked groove, place one end of a piece of fine cotton into one of the cuts, so that it shall be held there, then wind the cotton over all the wings on one side of the groove, so that it shall press them on the setting-board. and fasten it by drawing it into one of the cuts at the other end of the board. These wings being now pushed up to the required position are held by the cotton. Proceed in the same way with the wings on the other side. Then place a strip of tracing-paper the length of the board (the width varies with the size of the insects which are being set) over all the wings on one side, and place two pins above and two pins below each pair of wings. Apply paper in the same way to the wings on the other side, and arrange the legs and antennæ. Large numbers may be set in this way, but the condition of the insects is somewhat sacrificed to celerity, as the scales are very likely to be removed from the base of the wings by the cotton. *Quality* rather than *quantity* should be our maxim.

Some years ago there was a correspondence carried on in the pages of the 'Intelligencer' respecting the different methods of setting. On the Continent insects are set perfectly *flat*. Very long pins are employed, in many cases needles, which are thrust through the insects very nearly to their tops. The gentleman who initiated the controversy alluded to was a foreign entomologist of eminence, Dr. Staudinger. His object was to persuade English collectors to adopt the foreign method. Only three or four, I believe, gave in their adhesion. I am not surprised at the number being so small. I have seen many collections abroad and some at home, set in the foreign fashion; and I must say I cannot conceive a more hideous, unnatural, or ungraceful plan. I never look at a continental specimen of an insect perched up at the top of a pin or needle about three inches long, and its wings perfectly flat, without being irresistibly impressed with the idea that it has been first *painted* on a piece of stiff cardboard, and then cut out and pinned. Every one to his taste nevertheless, and some of my

readers may like to try it. I am, however, unable to give any directions as to the *modus operandi*. The insects should not be *finally* removed from the setting-boards until thoroughly dry. The length of time required to effect this will vary according to the state of the atmosphere, the size and sex of the insect and the Order to which it may belong. They must be kept perfectly preserved from both dust and damp. For this purpose tightly-fitting boxes, with sliding trays to hold the boards or blocks, may be procured.

As I have already hinted, it is both a difficult and troublesome matter to set an insect *well*. Yet, even when this is accomplished to the collector's satisfaction, he must not suppose either that his work is over or his troubles at an end. When the insects are arranged in the cabinet or store-box, there are three enemies lurking in secret about them. They are grease, mites, and mould.

A suggestion worthy of consideration has recently been made, to have the pins *pointed at each end*; so that if required an insect can be reversed to show under side without having to relax, repin, and reset it.

Grease.—This is the word employed to describe the oily or fatty matter which exudes from the bodies of many insects. It first appears in blotches on the abdomen, and, if neglected, extends to the thorax, corroding the pins unless black pins be used; thence to the wings, and finally to the paper; thus spoiling both the insect and the appearance of the cabinet or box. The *males* are *much* more liable to grease (verb) than the females, and those insects which have been kept some time in a relaxing box are especially liable. The following are among the insects which, sooner or later, are almost certain to become greasy, *viz.*, the "Clear-wings:" *Macrogaster arundinis* and *Zeuzera æsculi;* the genus *Hepialus*; the "Tiger" moths,—in fact, nearly all the Bombyces; many of the Geometræ, especially the genera *Selenia*, *Ennomos*, *Phigalia*, *Nyssia*, *Biston*, *Amphidasys*, *Hybernia*, *Eupithecia*, &c. Among the Noctuæ may be mentioned *Nonagria*, *Hydrœcia*, *Heliophobus*, *Charæas*, *Cerigo*, *Triphæna*, *Orthosia*, *Anchocelis*, *Cerastis*, *Xanthia*, &c. It would, however, be endless work to name all the insects liable to grease. It is sufficient to say that, so far as my own experience goes, four out of every five amongst the *males*, in all the Orders, are so. Certain of the butterflies are subject to it, especially those of the genus *Vanessa*. When an insect is thoroughly—body, legs, and wings—saturated with grease, it presents a deplorable appearance. All the brilliant colours and beautiful markings have vanished, and it becomes impossible even to distinguish the species. To restore an insect

thus "greased" many plans have been tried and many preparations used. Among the latter are—benzole, naphtha, benzine collas (the best in my opinion), camphine, rectified spirit of turpentine, ether, and chloroform. The insect is, by some collectors, wholly immersed in the preparation; by others the preparation is applied with a camel's-hair brush. It is then partially dried on blotting-paper, and afterwards covered over with magnesia or finely powdered French chalk. At the end of about twenty-four hours this is gently rubbed off with a camel's-hair brush, and the insect is found restored to its pristine beauty. Such at least is the result, as I have been assured by many eminent entomologists. I have not found it so myself. According to my experience the insect rarely possesses, after the operation, its original fresh and downy appearance; it is liable to become again greasy; and not unfrequently, especially in the case of the Geometræ, if wholly immersed, the wings will become hopelessly crumpled; at any rate, I have experienced all these misfortunes. They may, however, possibly be due to my performing the operation badly. Repeated failures, however, in *removing* the grease to my satisfaction, prompted me to try whether I could not *prevent* it. I have adopted, for some years, with complete success, the following plan, and I recommend it with much confidence. To illustrate it, let us take a male *Notodonta dictæa*. When the insect has been on the setting-board a sufficiently long time to render the contents of the body firm and viscid (not *hard* or *dry*) remove it. Take a pair of sharp fine-pointed scissors, and cut from the under side of the body a small slip, *i. e.*, beginning at the extremity of the abdomen on the *left*-hand side, cut up to the thorax; and having done the same with the right side, remove the slip thus made. Care of course must be taken not to cut too deep. Take now a sharp penknife, and, inserting the point at the thorax, draw it gently down each side of the body. It will be found this can readily be done, if the contents are not *hard*. The interior, when thus loosened, can easily be picked out with the point of the knife, or a pin or needle. In very small insects, as *Eupithecia*, &c., instead of a knife a fine needle must be used, and great care and caution are necessary. In a moth, however, like *Notodonta dictæa*, the contents of the body will frequently come out in one lump. When this has been effected, break off the body within twenty-four hours, taking care that the *under* wings do *not* come off with it. If the body is left on for any length of time, the grease will run into the thorax, and your labour be in vain. Take now a very fine pin, and run it through one *side* of the empty body for about one-sixth of an inch. Let it remain thus for a few days until thoroughly hardened, and then immerse it in any of the above-

named fluids for about six hours. Afterwards dry it on blotting-paper, which will in most cases be found sufficient, especially if the fluid employed has been benzine collas. The bodies may with great benefit be exposed to the *sun*. Very *feathery* bodies are, however, improved by covering them over with magnesia for a day, having previously dried them on the blotting-paper for about a quarter of an hour. The magnesia may then be *blown* off, or, if it should cling to the body (which, however, very rarely happens), it can be gently rubbed off with a camel's-hair brush. After this process the body will be found wholly free from grease, and can be reunited to the thorax with a little strong gum. If kept for years it never will, or, indeed, *can* grease; all *moisture* being gone, the pin can never be crusted with verdigris; and last, though perhaps not least, the contents of the body having been removed, and the *shell*, so to say, having been well soaked, the insect is comparatively safe from *mites*.

The object of running a pin through the side is—*first*, that by means of it the body can be removed from the benzine collas with a pair of scissors, without injury; and *secondly*, for the purpose of attaching a little paper label to it. The object of this I proceed to explain. It would obviously be a troublesome business to soak each body *separately* as it became ready. Having therefore, suppose, twelve pupæ of *Notodonta dictæa*, which emerge at different times during a fortnight, I clean each as it is ready, and, having broken off the body, attach to the pin a little paper label, numbered 1, 2, 3, &c., corresponding with a similar label attached to the insect. This is of course that each insect may obtain its own proper body. The number must be written in *pencil*, as if in ink it will be obliterated. The body will sometimes be found filled with a dark fluid. In this case take a little roll of blotting-paper, and fix it in the body. This will absorb the moisture. Afterwards insert it in the benzine collas, as above. The method may appear a little elaborate, but in reality it is as simple as possible. It demands a little trouble, no doubt, also a little patience and practice. But the result more than repays you. It may perhaps be objected that this is "patching" an insect. If well done the operation will escape the most critical eye. Sometimes the body *contracts* a little after the interior has been removed. This, however, may almost always be obviated by not "operating" too soon, and by letting the body remain some days before immersion into the benzine collas.

I adopt this plan with all insects taken or bred by myself, and, as far as possible, with those received from correspondents. In this latter case the operation is much more difficult, owing to the *hardness*, and in some instances the *antiquity*, of the

specimens sent. If the wings of the insect, when removed from the setting-board (in order to prepare the body), are not thoroughly dried or stiff, it must of course be replaced and reset, not forgetting to attach the label. The bodies of insects which have been taken at *sugar* will frequently be found completely filled with the composition. To remove this nothing is required but little rolls of blotting-paper, and it will not be found necessary to *immerse* the body. Sometimes, however, the composition will, after death, exude through and soak the body. When this occurs the body must be opened, and the composition removed with the blotting-paper. The body must then be broken off, and soaked for a quarter of an hour in boiling water, and afterwards thoroughly dried at the fire. Every trace of discoloration will then have disappeared. Whatever credit may be given to these plans is due *solely* to myself, but I have no intention of taking out a "patent" for them. I shall be more than satisfied if my readers will adopt them, for I feel certain that the result will amply repay them. A good plan is to have, say, a dozen wine-glasses, numbered 1 to 12, with the edges ground so as to prevent the escape of the benzoline in which to soak a greasy body, and then to pin the insects, the bodies of which have to be cleaned from grease, in a row. The body of the first can be placed in wine-glass numbered "1," and so on. There will thus be no difficulty in placing the right body on the right insect when the grease has been removed. The wine-glasses are covered by a small square of glass.

Mites.—When these little creatures go into the cabinet or store-box they make sad havoc. That distinguished entomologist, the late Mr. Haliday, gives the following directions for "killing and excluding" them:—"For the former purpose invert the drawer uncovered over a sheet of blotting-paper or cloth moistened with liquid naphtha, for one hour or more. Steam, or fumes of prussic acid cautiously applied, might be still more certain: but there may be certain objections to each. Naphtha is safe, injures no specimens, and requires no apparatus.* At all times take care that the drawers (and boxes) *close* accurately, and keep them in a *dry* and *airy place*; let them be supplied with *naphthaline* in niches all round (or, if *boxes*, with pieces pinned firmly into them). Go over all the drawers at stated periods of the year, replenishing them with napthaline, and, if there be any suspicious appearances (*i. e.*, 'frass' under the specimens), employ-

* Benzoline also answers the purpose.

ing the fumigation above named. Place no specimens obtained from other collections in your drawers without leaving them first for some time in the fumigating-box." These directions are excellent, and should be carefully followed out. Mr. Stainton advises a composition of "equal parts of oil of thyme, oil of anise, and spirit of wine." Let a drop of this be placed on the under side of a highly infected specimen, and let a drop or two be placed in each corner of the drawer and box. This is the preparation I employ myself, and I think it is as good, and certainly as simple as any other. Another plan, and one which has, in certain cases, answered admirably, is to procure some of Calvert's glacial carbolic acid, which may be obtained through any druggist; dissolve it by placing the bottle in warm water, and then put a few drops on cotton wool, which may be placed in the cells surrounding the drawer, or which may be pinned to the cork. Take the precaution to push the wool well up the pin, so that the carbolic acid may not discolour the paper before it hardens. Two grains of corrosive sublimate dissolved in one ounce of absolute alcohol, applied by a camel-hair brush to the under side of the body of an insect, will kill mites and prevent the growth of mould.

[Bisulphide of carbon has been recommended as a "mite-destroyer," and, while not doubting its efficacy to this end, it should, however, not be used, as its effects are no less prejudicial to any one inhaling its vapour. Dr. Bœhm, in his contribution to the 'Cyclopædia of the Practice of Medicine,' edited by Dr. H. von Ziemssen, Professor of Clinical Medicine, points out the disastrous results accruing to those who inhale the vapour of bisulphide of carbon. Those who desire to learn what these results are may be referred to the 'British Medical Journal' of September 20, 1879, p. 452.—A. B. F.]

Mould.—This, in my opinion, is the worst enemy the collector has to deal with. No precaution can *wholly* prevent it. Of course the *drier* the room and the situation of the cabinet or boxes, the less likelihood is there of the specimens becoming mouldy; but I have never been able entirely to exclude it. I know of only one remedy, which was very kindly communicated to me by Mr. Doubleday, in a letter to Mr. Newman. I give his own words:—"Every insect ought to be touched with a weak solution of bichloride of mercury in alcohol. . . . I believe insects *never* get mouldy when this is done." Mr. Newman adds that another correspondent declares that "mould is impossible if the cabinets are kept in a proper place." I can only say I wish I knew what the "proper" place is.

[To an enquiry in the 'Entomologist' (xi. p. 23) the editor writes:—"The best preventative known against mould on cabinet specimens of insects is glacial carbolic acid. This may be obtained in small bottles from any chemist. The readiest way of applying it is to place the bottle, having first removed the stopper, in a cup of hot water, which thaws the frozen acid. Then have a little piece of cotton-wool, about the size of a pea, placed on the head on a small pin; this must be soaked in the warm fluid acid. As soon as exposed to the air, in ordinary temperature, the acid on the wool hardens, and then the pin may be stuck in the cabinet drawer: two of these pieces of cotton-wool, so soaked, in each drawer, will deter any further spread of the microscopic fungus called mould. All specimens already attacked with this fungus may be cleaned with the preparation of alcohol above mentioned. But the greatest preventative of all is to keep the cabinet or store-boxes in a dry room. We may also note that, in answer to an enquiry, Mr. G. R. Crotch gave the following method in the third volume of the 'Entomologist,' p. 72:—'The best way of removing mould from the wings is to dry the insect thoroughly before the fire, and brush it off with a camel's-hair brush. From the antennæ it can be removed by the above application (one part of carbolic acid to ten of benzine), which might with advantage be applied to the under surface of the body. A slightly stronger solution, brushed over the corners of the drawer and the glass frames, would probably check any further development of mould, as also of mites.' The enquirer, Mr. F. Wilkinson, tried this plan, and found it successful."]

Cabinets and Store-boxes. — When the insects are thoroughly dried it only remains to arrange them in the cabinet or store-box. I shall say no more on the subject of cabinets than this—that they should be made *entirely* of oak or mahogany. The drawers must be glazed, lined with cork, and have cells round the sides to admit pieces of naphthaline, which will have to be renewed from time to time, only a small quantity being placed in each drawer. Cork linoleum, or corticine, is sometimes employed instead of cork, and has the advantage that the surface of the bottom of the drawer is quite uniform, and there are no hard pieces to bend the pins when arranging the collection. It has the disadvantage of being heavier than cork. Whether in the course of years it will always remain soft has yet to be proved. The dimensions of the drawers must be left to the fancy of each collector; eighteen inches by twenty is a good size. In my own cabinet, which contains thirty-six drawers, the dimensions of each drawer are as follow:—area in the clear, seventeen inches and

a half by sixteen; depth, in the clear (*i.e.*, exclusive of the cork), one inch and an eighth. Many, probably, of my readers, however, will be unable to afford the cost of a cabinet, at any rate at first. In this case store-boxes must be procured, which should be of the size and shape of an ordinary backgammon-board. Great care must be taken that, when shut, the two sides fit closely and accurately, so as to exclude as far as possible all dust, mites, &c. The box must be lined with cork, a quarter of an inch thick. This is then covered with white paper (not too thick or it will turn the point of fine pins). For the same reason, it is better that the paper should be affixed to the cork with *paste*, not gum or glue. Store-boxes containing insects should be ranged upright on shelves, as are books.

Painting.—Before placing the specimens in your cabinet, I would recommend that the paper should be painted with the following paint:—Dissolve about a drachm of isinglass in half a pint of boiling water. Let this solution stand until cold; then remove the clear jelly; warm this, and mix it with the best zinc white (oxide of zinc), and an additional half-pint of water, until you have a paint of the consistence of a good cream; stir in, until perfectly mixed. An almost imperceptible amount—I cannot give the weight—of ultramarine blue (this seems not to make the mixture blue, but to appear more white), and an addition of two grains of powered white arsenic is useful. This paint is whiter than paper, and improves the appearance of the drawer when properly applied. Besides it prevents the diffusion of grease, if there be any in the specimens. The grease will collect under the bodies, and is turned into a sort of wax, which may readily be removed, the transition being caused, I am told, by the chemical properties of the paint. As regards mites, too, the paint seems to deter them to a certain extent from attacking the specimens.

Take the drawer to be painted and warm it at the fire, and have the paint over the fire (in my case "stove" in a jar standing in a saucepan of water. Then take a flat fine-haired brush about two inches in width, and, while both drawer and paint are warm, paint the drawer first from side to side, and then from front to back. Take care to put the paint on as evenly as you can; this requires but a little practice. Then turn the drawers down to keep out dust while they dry; for this I allow twenty-four hours in a warm room.

Arrangement and Nomenclature.—With regard to these, I believe the majority of collectors used to adopt both one and the other as in Doubleday's 'Synonymic List.' This

work is a monument of patient industry and laborious perseverance.*

Number of Specimens and Manner of Placing.—Each specimen should bear a label giving locality and date of capture. The number of specimens to be placed in the cabinet, and the manner of placing them, must evidently be optional. I do not think, however, that the number should ever be less than *four* at the least. This number is obviously insufficient to show local forms, quite apart from occasional varieties. The following method of arrangement can be followed by my readers or not, as they like. The general principle of it is this—that each drawer shall be divided *horizontally* into two, three, or any number of equal parts. These are crossed by perpendicular lines, the width between them varying of course according to the size of the insects. Now, suppose that there are in a drawer ten such *upright* divisions. These being multiplied by three, we have thirty spaces, all equal in *length*, though varying of course in *breadth*. Commencing at the left-hand top of the drawer, place in the middle of the division the *generic* name, fastening it with a little thin paste, or a fine pin. Then follow the insects, until the allotted space is filled; and next the *specific* name, which is attached as before; and so on with the next. Whenever a genus (having more than one species in it) *ends*, the next *generic* name is placed immediately under the preceding *specific*. By this method a very pleasing and symmetrical effect is produced, and by running the eye *across* the drawer the name of an insect is discovered at once. The perpendicular lines must be marked out first, from top to bottom, with a pencil; I mean, of course, ruled.† If the drawers have been painted with zinc-white, the lines are best drawn by using the point of a common pin. This makes an exceedingly fine line of uniform width. In marking out these lines, the following precautions must be taken. Supposing row No. 1 is intended to contain *three* species. Then the *largest* specimen must be picked out; I mean the largest specimen which will occur in that row when it is filled up. Place this specimen at the top, and mark out, with a pencil dot, the required width. Proceed in the same way with the next and the next row, until the drawer is filled. For example, suppose your first row is intended to contain the three following species:—*Agrotis valligera*, *A. puta*, and *A.*

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* This list is now out of print: its place is taken by the 'Entomologist Synonymic List,' by Richard South, F.E.S. London: West, Newman & Co., 54, Hatton Garden.

† This plan cannot be carried out *completely* in *every* drawe

suffusa. Now, *A. suffusa* is the largest species, and of course the largest specimen of *it* must be chosen. Place it as directed. The three species for the *next* row will be *A. saucia*, *A. segetum*, and *A. lunigera*. Here *A. saucia* will be the largest species. Proceed then with it in the same manner, and so on to the end of the drawer. The distance *between* the specimens when thus laid side by side must be optional. Place them close, short of overlapping. The *horizontal* line is marked out by a dot only in each division to show where the names are to come. In using this plan, however, it will be obvious that, as some insects are larger or smaller than others, fewer or more specimens will be required to fill the spaces. Sometimes the species will come rather awkwardly. However, not to dwell too long on this matter, this method (with some exceptions) may be adopted in the Bombyces, Noctuæ, and Geometræ. In the two former divide the drawers into *three* and *four* horizontal sections; in the latter, into *three*, *four* and *five*. In all these cases from six to twelve specimens are sufficient to fill up the spaces. In one or two drawers divide the first half into three, and the second into four, sections. There are one or two other little difficulties and objections, which I do not enter upon here, for two reasons—*first*, if my readers, or any of them, do *not* adopt my plan, it is unnecessary; and, *secondly*, if they *do*, they will soon find them out for themselves, and soon overcome them, to their own satisfaction at least. Whatever arrangement may at first be adopted, some modification will be inevitable as time goes on. Species considered very rare will become more common, and species (especially among the *micros*) be discovered new to this country, or new even to science—not to mention the growth of an ambition to have local varieties well represented and the desire to obtain extreme and intermediate forms of occasional varieties.

It only remains for me to say a few words about "relaxing" insects and transmitting them by post, and upon entomological books, &c.

Relaxing.—When an insect has been badly set, or not set at all, it must be relaxed. This is very easily done, in various ways. Mr. S. Stevens says: "I procure about a dozen shoots, with the leaves, of laurel (the younger the better), put them into a coarse bag or cloth (shot-bag I use), bruise them well with a wooden mallet till the bag becomes quite moist; then put it into a jar, or other wide-mouthed glazed vessel, and stick the insects on the top of the bag, which [the jar, I presume] must be tied over with a bladder, or secured in some way, so that it is perfectly air-tight. Twenty-four hours are generally sufficient to relax most insects; but one great advan-

tage is, that if they remain a week or ten days in the laurel they are not in the least injured, so that they can be set out at any convenient opportunity; it also completely destroys the mites or mould, if the specimens happen to be infected. The colours of green species, such as *papilionaria*, *vernaria*, and *cytisaria*, are, however, considerably changed by it." (Zool. iv. 1443.) The following is my own very simple plan:—Get a vessel of any kind, and half fill it with water. Place in the water anything that will stand steady. The top of it must be a couple of inches above the surface of the water. Take then a piece of cork and soak it. Having partially dried it, stick the insects on it, not letting the wings or body (if possible) touch it. Then place the cork on the block, or whatever it may be, in the water, and cover over the vessel with a damp cloth. I have relaxed insects with the utmost ease in this way, in periods varying from six to twenty-four hours. Simple pinning the specimens to be relaxed in a zinc box lined with cork which is saturated with hot water (the surface of the cork being partially dried by blotting-paper) will be found very efficient. There is one hint about re-setting an insect which is valuable. Relaxed insects, when re-set, are very apt to spring back, especially in damp situations, but this may as a rule be obviated by not attempting to set the specimens until thoroughly relaxed, and then allowing them to remain on the setting boards for at least a month. The way in which I have obviated this is by putting a small portion of liquid glue under the wings, at their juncture with the thorax. Gum will not do, as it does not adhere, but shellac dissolved either in chloroform or spirits of wine is superior to liquid glue. A pin with the head cut off, and fixed into the feather end of a quill pen, is as good as anything for applying the glue. Care must be taken not to put too much glue, else it will stick to the setting-board and spoil the insect. When an insect has been relaxed (according to my plan) and re-set, I place it for a quarter of an hour or so before the fire, at about a yard distant. This is to remove any moisture which may possibly remain, and which would render the insect liable to mould. I may just add that an insect set with the liquid glue will be ready to be removed from the setting-board in twenty-four, or at most forty-eight, hours. By damping the bases of the wings on the under side with wood naphtha (pyroxylic spirit) the wings are rapidly relaxed, but the insect must be re-set at once. No injury to the wings ensues.

Transmission of Insects by Post, &c.—Insects may be sent through the post with tolerable security, if proper precautions are taken. In order to save postage the boxes should

be as light as possible, consistent with strength. The more *convex* the box, the greater the strength. Chip or pill-boxes should only be used when it is desired to employ an expensive method of destroying insects. If of sufficient depth, the box should be lined with cork at the top and bottom. The insects should be *firmly* fixed in the cork. If there be a specimen which will not hold firmly, don't send it at all; it is almost sure to injure both itself and its companions. Place pins transversely across the bodies. If the bodies are unwieldy, it is as well to place a third pin at the extremity of the anus. Some persons put a little cotton-wool under each specimen. Having closed the box, tie it as *tightly* as possible. This is one of the most essential requisites for a prosperous journey. Then roll the box in cotton-wool. *Don't spare it.* It may perhaps cause an extra penny in the postage, but surely it is better to give that than run the risk of having your insects destroyed. Let me, then, repeat to my younger readers, *don't spare* the cotton-wool. Next wrap it up in *black* glazed calico, and fasten it with sealing-wax. Some persons *sew* it, but this is unnecessary, unless you are anxious to take a few lessons in that useful accomplishment. Lastly, tie a label to the box, and the operation is complete. The label, of course, contains the address and stamps. If these directions are carefully attended to, insects will, in the great majority of cases, travel quite safely. Perhaps the best way to send insects by parcels post, or by rail, is to pack the box within a larger one, and surround the insect box with cotton-wool or other good packing, just so firmly that it cannot shift; that is, fill up the space between the two boxes. In passing, let me say, don't send greasy, mouldy, mitey or damaged specimens, unless you have previously notified to your correspondents that they are so. I cannot refrain here from making an extract or two from a letter, addressed some years ago to the Editor of the 'Intelligencer.' The writer had been accused of keeping a correspondent's box. In his reply to the charge he describes four boxes (with their contents), one or other of which he says must be the one alluded to. The portraiture of boxes 3 and 4 is one of the most amusing things of the kind I ever read. For its accuracy in *other* instances I can confidently vouch from a very considerable experience :—"No. 3 box containing a miserable Pyrale, with pin-holes through its scaleless and fringeless wings (described in the promissory note as a 'fine bred specimen of *Stenia punctalis*'); for this a long series of several species is requested, as the correspondent's series is 'three rows of each insect.' No. 4 large box containing fragments of various species, several bodies, and antennæ not only broken off, but missing; these insects (which are entitled to respect on

account of their venerable appearance and undoubted foreign origin) have been liberally anointed with some greasy liquid for destroying mites." I have enjoyed many a hearty laugh over this description, and I trust my readers may do so likewise; but let me earnestly caution them against imitating such unworthy and disreputable conduct.

Transmission of Larvæ and Eggs by Post. — Larvæ may be sent by post in tin boxes, in company with some of their food. Care, however, should be taken to have the food freshly gathered, but quite free from external moisture. If, too, the larvæ be large, the lid of the box should have small perforations. Unless, however, the larvæ are very small or quite young, it is a dangerous experiment, as they will bite each other, and the confinement is more or less injurious. The best plan for transmitting *eggs* is, I think, to put them in a quill, and close each end with a bit of cotton-wool. They can then be forwarded in an envelope. Or they may be put in a *flat* pill-box, which must itself be put into another. I recommend the quill.

Entomological Diary. — A diary of captures should be carefully kept, recording locality, date, condition, numbers of the various species, also any other details worth recording. This will be found not only to afford considerable amusement when, as in winter time, we desire "to fight our battles o'er again," but will assist in refreshing the memory when the time for collecting comes again. If, too, meteorological remarks are included, valuable information will accumulate bearing upon the influence the weather has on the dates of appearances of species.

Entomological Books, &c. — Of these so many might be named that I must be content to mention one or two only which will aid the beginner, and then must leave any further selection to him as his experience may dictate. Stainton's 'Manual of British Butterflies and Moths,' although written so many years ago, has not been superseded; but it is a matter of regret that it has not been brought up to date. The lepidopterist should certainly not be without it. South's 'British Butterflies' will be found a useful companion. The 'Insect Hunters,' by Edward Newman, which, in simple and graceful language, treats of the four stages of insect life, of Lepidoptera and all Orders, and of classification. It is written in verse, and is addressed to a child, but contains nevertheless such sound information as can scarcely be found elsewhere. But, beyond all comparison, the best works are Newman's 'Illustrated Natural

History of British Moths,' and 'Illustrated Natural History of British Butterflies.' They contain, with a few exceptions, all the recently discovered insects. The descriptions of the *perfect insects* are full, and as clear as it is possible to make them by word-painting, while those of the *larvæ* are drawn up with a care and minuteness almost too elaborate. But the marvel of the books is the woodcuts: they are truly *wonderful*, and, though not coloured, yet, in the vast majority of instances, I venture to think that the veriest tyro will at once recognize his insect, upon comparison with the figure. In my opinion they are by far the best elementary works on British Lepidoptera, and no collector should be without them. Lastly, I recommend to my readers the 'Entomologist.' This periodical is issued every month, and contains interesting records of captures, descriptions of larvæ, exchange lists, and entomological information generally. The 'Entomologist's Monthly Magazine' may also be mentioned. and the 'Entomologist's Record.' In these periodicals will be found the latest information as to captures of species new to this country, also descriptions of *larvæ* hitherto undescribed.

CONCLUDING OBSERVATIONS.

A few words on some other branches of Entomology may here be given. Although Lepidoptera and Coleoptera have the larger number of followers, yet, for this reason, the other families offer to the student a better field for discovery.

Of Diptera, or two-winged flies, there are, I believe, some nine or ten thousand known species in Europe. Their habits are as variable as are the different parts of their bodies. The structure of different genera is abundantly distinct, and offers a tolerably ready means to differentiate them. Dipterous larvæ may be found in mud under water, mining leaves, hollowing the stems of fungi, in lepidopterous larvæ and pupæ, under the skins of living animals, in man himself, &c. Sometimes they are only too prominent—repulsively prominent—in our food; but when they come in the form of "hoppers," as the dipterous larvæ in cheese are called, they are partaken of by some people with evident relish. "Gentles" are not, therefore, palatable to fish and birds alone.

Flies may be killed in the "cyanide bottle:" the larger species pinned; the smaller mounted on card. It is a good plan, in cases where the specimens have long and fragile legs, to push up the pin under the body a piece of card. The card will support and protect these.

Hemiptera (bugs). While "sweeping" for lepidopterous

larvæ, or for Coleoptera, many species of this order will be found, some making their presence known by their unpleasant smell; others are beaten from trees and shrubs into an umbrella. They may be pinned through the triangular scutellum, or mounted on card like the smaller Coleoptera. Where possible the wings of at least one specimen of each species should be extended.

Orthoptera (grasshoppers) should be pinned like the Hemiptera, and their wings can be extended. A piece of card pushed up the pin under the body will support the hind legs, which are apt to break off.

Neuroptera (dragonflies). The brilliant colouring of certain of the dragonflies is sure to attract attention; but, unfortunately, these colours most frequently change, and the bright hues are thus lost. It has been recommended that the intestinal canal should be removed by cutting open the abdomen underneath, and the space filled by cotton-wool. The wings may be extended on a setting-board. The bold flight of the Libellulæ is well worth watching. When hawking for flies and other insects they seem masters of the situation. A specimen of the large species which may often be seen in gardens once attracted the attention of a non-entomological gentleman, who gravely told me that he thought it the most extraordinary creature he had ever seen, as, although he had paid great attention to it, he had never seen it turn in its flight. "It flew up the path in the garden, and then, without turning, flew back again." This, probably, has never been noticed by entomologists.

To a beginner in pursuit of entomological knowledge, and to one who would wish to try comparatively unbroken ground, I would suggest that he should collect a single family (more if he be ambitious) of some group, and form a collection which should represent not only the life-history of the species in that group, but the life-histories of their parasites. It is here that he will make discoveries of deep interest to the naturalist, and be pursuing a branch of knowledge which has hitherto been much neglected. Who, among lepidopterists, for instance, pays more than a passing attention to an Ichneumon or a Dipteron which he finds in his breeding-cage? Perhaps he squeezes it somewhat viciously (as a sort of revenge for the loss of the butterfly or moth from whose pupa it came), and relieves his feelings by anathematising it. He may, if it be strikingly coloured, kill and pin it. But there his interest as a rule ceases. Now, if he would only try carefully to learn the history of the parasite, so that he may know it as thoroughly as he knows the history of the butterfly or moth from which it came, he would be doing good work. Two of the most interesting

cases which were shown at the Entomological Exhibition, held at the Westminster Aquarium in 1878, were those exhibited by Sir Sydney Saunders, in which were bees inhabiting the stems of brambles, and their hymenopterous and other parasites. What does the lepidopterist or coleopterist know of the intestinal worms which have passed more or less of their lives in his specimens? Very little, I fear. Yet these parasites may be more terrible to mankind even than are the Carnivora, because their attacks are more insidious, and we are proportionately defenceless.

As regards the dipterous parasites of Lepidoptera, I have seen a fly deposit its eggs on the skin of larvæ. I once saw a larva of *Bombyx neustria* attacked in this way. The larva was undergoing change of skin, and was therefore somewhat unprotected. The fly made cautious advances until close to the larva; it then turned its abdomen underneath itself and thrust out its ovipositor between its legs. It could thus see where to deposit its egg. Lightly touched as the larva was, it threw itself from side to side violently, perhaps knowing the dangerous enemy which had touched it. The fly flew to a neighbouring leaf until the larva was quiescent, when it cautiously advanced and deposited another egg in like manner. Again the larva twisted about for some little time. The whole proceeding was repeated several times.

Then there are the microscopic parasites. The silkworm disease, "pebrine" as it is called, is considered by Pasteur to be due to microscopic parasites, having for their head-quarters the silk-producing glands of the silkworm, and by their numbers so filling these glands that no silk could be secreted. These parasites have been found in every stage of the silkworm—egg, larva, pupa, and imago. It seems almost as if the importance of the creature were in inverse ratio to its size. Possibly no question of Economic Entomology is of greater moment than that of the silkworm disease, while certainly there are few, if any, known parasites smaller than those which are the causation of it.

I shall now bring this little work to a close with two or three general observations.

"Mere collectors" is a phrase which I have often heard and read. It is used as a term of contempt. Why? Is there anything *contemptible* in a poor or a rich man's making a collection of some of the most beautiful and wonderful of God's creatures, even though his object be only to please his eye? Is there anything *contemptible* in a poor man after he returns from a hard day's work, taking down his boxes or glass cases, and admiring his insects, even though they be not scientifically arranged? Is there anything *contemptible* in the

sight of a number of mechanics, or men even of a humbler grade, gathered together while they examine each other's collection, and recount where that "beauty" was taken, or how that "rarity" was discovered? I only wish we saw such spectacles more frequently. When I hear scientific magnates, so called, speaking sneeringly and slightingly of "mere collectors," I am tempted to inquire, "What benefits have your *scientific* investigations conferred upon yourself or upon others? Do you feel that your mind has been enlarged by investigating the anatomy of a *flea?* Or is the social and moral state of mankind improved and advanced by the circumstance that a celebrated naturalist devoted some of the best years of his life to the discovering the number of muscles in the body of a caterpillar? I do not for one moment wish or mean to depreciate true scientific acquirements. I am only desirous to defend from *contempt* those who do not possess them. The "mere collector,"—if by that term be meant one who enjoys the *act* of collecting insects; who derives satisfaction from watching their habits and transformations; who employs his leisure hours in arranging them, even though it be unscientifically: and who, when all is done, looks with pleasure at his collection, or points it out with pride to a visitor,—the "mere collector" has my heartiest good wishes, for I fear I am little more than this myself. Observe, I am far from wishing to *restrict* my readers. Try by all means to find the time for going deeper into the subject; but when you have ascended some dozen rungs of the ladder, don't look back, with a smile of pity, upon those who are at the bottom, and say "mere collectors!"

Let me at the same time caution you against a too eager desire of accumulating specimens. And this leads me, by an insidious gradation, into the delicate subject of *exchange*. In laying it down as a general principle that I decidedly *approve* of exchange, I am aware that I express an opinion adverse to that entertained by some entomologists. It would, however, I think, be a *serious* omission, in a work of this kind, to avoid all mention of such a subject as this, or to shrink from stating plainly my views on it. Those views, let it be remembered, are the views only of a single individual, and are put forward merely as representing my own private and personal opinion. I lay it down, then, as an axiom, that no one *objects* to receiving insects in exchange (or in return, if the *word* "exchange" is disliked) for insects sent to a friend or correspondent. Am I wrong in adding that when A sends B a box full of good local insects, he (A) entertains a "lurking hope," not to say expectation, that B will send him (A) something in return, though nothing has been *said* expressly to that

effect? How many can lay their hand upon their heart and say, "Not guilty, upon my honour"? Now, is there anything to be *ashamed* of in entertaining this expectation? If there be anything to be ashamed of, it consists in this, in my opinion, that A fears to *express* what he hopes or expects. Is there anything to be ashamed of, I ask again, in the expectation itself? I venture to express a very decided opinion that there is *not*. For example: I go out after *xerampelina*. I spend perhaps six hours (I have often done this) in one day, and bring home two pupæ. Working in this laborious way (and let those who may doubt the labour only *try* it) I obtain perhaps twenty pupæ by the end of the season. When the moths emerge, I kill, pin, set them out, and clean the bodies. Soon comes a letter from a comparatively unknown collector to this effect, "I hope you have been successful with *xerampelina* this year; I shall feel much obliged for a specimen or two," &c. If I *do* send them, am I, or am I not, entitled to expect a return? Is it unreasonable? If it be, why is it? It is absolutely useless to din into my ears the oft-repeated platitude, "those who *give* most will *receive* most." I *know* the contrary. Some years ago I made a *free* offer of some uncommon insects, *dodonæa*, *trepida*, &c. I received hosts of applications. I supplied with two or more specimens upwards of twenty-four of my correspondents. From that day to this I have never heard from *one* of them—*i. e.*, voluntarily. Were I to proclaim that I had *bicuspis* or *sphegiformis* to *give away*, I should probably heard by return of post. This remark, be it observed does not apply to my *friends*, nor to all my correspondents. Among these latter I could gladly mention some shining exceptions, were it not that they would probably be unwilling to have their names brought forward in so public a way. Further—I consider it an unanswerable argument in favour of exchange that, without it, very few can hope to make a collection, unless of the most limited kind. How is a northern collector to obtain southern insects, and *vice versa?* How is a poor man, or a man of business, residing in Suffolk, to procure the "Lulworth Skipper"? How is the Devonshire labourer to obtain *Lithosia muscerda* or *Agrophila sulphuralis?* The answer clearly is, by exchange, and by exchange alone. It is quite true that the gentleman who has ample leisure and a full purse may pack up his carpet-bag or portmanteau, and take a first-class express ticket, as soon as he hears of some new or rare species turning up. But I suspect that leisure and money are among the *desiderata* of most entomologists. It is also true that there are others who, though they have no *leisure*, have *money*, and can buy specimens or employ men to

collect for them. But the same objection meets us. Naturalists, as a rule, are not *rich* men. So strongly persuaded am I, not only of the propriety, but of the necessity, of exchange, that I should welcome with joy a "monthly" wholly devoted to it.* As to the manner of exchange, the relative value of insects, &c., such matters must be left to the individuals concerned. Of course I am aware that, by some, these views will be met by the usual epithets, "mean," "illiberal," "peddling," "derogatory to Science," and so forth. I am supremely indifferent on this head. When it has been proved that that which is permitted and done without hindrance or prejudice in every other pursuit or occupation is in this case alone unjustifiable or objectionable, I hope I shall be "open to conviction." In default of such proof, I shall continue to be a warm advocate of "exchange." But, when exchanging, do not attempt to deceive or "take in,"—do not take advantage of the inexperience of a *beginner*,—do not send bad specimens without previous notice—in a word, "Do unto others as ye would that others should do unto you."

One other observation. When collecting we must be prepared to encounter a little ridicule from the unconcerned or astonished spectator. No one likes ridicule,—at least *I* don't,—and I confess that, when fully equipped, I don't court observation, but avail myself of the least frequented by-ways to reach my hunting-ground. That eminent arachnologist, the Rev. O. Pickard-Cambridge, gives a most amusing account of his emotions on seeing a rare spider running on the pavement in one of the most crowded thoroughfares in Edinburgh:—"The passers-by would occasionally stop, probably wondering what the tall parson could be about picking up and bottling small black specks off the pavement . . . . made me feel uncomfortable, for I confess that I always do feel just a little so, for a moment, when a spider has to be captured under public gaze. To care absolutely nothing for what people think (and sometimes say) on such an occasion, is a difficult lesson to learn thoroughly. Some entomologists of my acquaintance will walk through a town, net in hand, with the utmost indifference; but, for my own part, I much prefer secreting the implements of the craft in my pocket until far from the gaze even of an enlightened British public." Talking of an *enlightened* British public reminds me of a little incident that occurred to myself. I had been pupa-digging for some

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* 'The Entomologist,' published by West, Newman & Co., 54, Hatton Garden, London, price sixpence, now meets this requirement.

hours at the roots of various trees. I won't name the place or the county. During the whole time I observed a man standing at a respectful distance, and watching me as I went from tree to tree. Being well accustomed to such supervision, I thought little of it at the time, but shortly afterwards I was informed by a brother clergyman that, as soon as I left, the man hastened home, procured a large spade, and forthwith commenced "digging" on his own account at the trees, not for *pupæ*, but for *money*, which, as he supposed, I had been hiding! Nor is the surprise caused by our proceedings always confined to the genus Homo. I remember, on another occasion, being "out" with a brother naturalist, on a pupa-digging expedition. Our occupation, was pursued under difficulties, for, it being a steady downpour of rain, an umbrella was held in the left hand, while, with the right, the trowel was worked as best we might. I had been digging for nearly a quarter of an hour at one tree, under the shelter of the umbrella. Upon standing up to relieve my aching back, I found myself surrounded by a double "cordon" of sheep and cows. The inner circle was formed of the sheep, the outer of the cows. The solemn, open-mouthed wonder of the sheep, and the grave, dignified astonishment at my proceedings expressed in the faces of the cows, was one of the most ludicrous sights I ever witnessed. The ridicule of the uninitiated and ignorant is, however, very much less than it was twenty years ago, when, as a boy, I began to collect "bootherflees" in the ancient city of York. This is doubtless to be attributed partly to the spread of education, and partly to the vast increase of entomologists since that time.

Before launching my little bark on "entomological waters," it should be remarked that, in the composition of my portion of this work, *one* object has been kept steadily in view—to make it thoroughly *practical*. Care has not been taken to employ polished or refined language, much less has anything approaching what is called "fine writing" been attempted. I shall not, through any affectation of modesty, scruple to say that I think it will be found useful to the "beginner," for it contains the results of many years' experience of myself and other *practical* collectors.

To end a book well is perhaps as difficult as to begin and carry it on well; but I trust my readers will agree with me in thinking that no better or fitter words could be found to conclude a work of this nature than those of the Psalmist: "O Lord, how manifold are Thy works; in wisdom hast Thou made them all; the earth is full of Thy riches."

MICRO-LEPIDOPTERA.

By A. B. FARN.

Although many of the directions given in the foregoing pages are applicable to the Micro-Lepidoptera,* a few words specially devoted to this group—large in number of species, though small in size of the specimens—may be here inserted.

The larvæ of Micro-Lepidoptera are ubiquitous; mining roots, stems, buds, and leaves of plants, grain, fruit; destroying textile fabrics, eating animal substances, as horns, furs, and feathers. Even pupæ in our breeding-cages are not safe from their attacks, as most rearers of insects but too well know. It is this very diversity in their modes of living which—apart from the beauty and delicacy of structure—add an especial charm to the rearing of Micro-Lepidoptera. Everyone must have noticed the rolled-up leaves inhabited by larvæ of the family of Tortrices, so conspicuous on our cultivated roses; perchance, too, seen the bloated body of a Tortrix larva among cooked peas or in plum pie—*vide* Mr. Stainton's 'Manual.' But it is not everyone who has observed leaves twisted by the larvæ of the Gracillariæ into curious cones, or the sinuous mines tenanted by the larvæ of the Nepticulæ; the cases, in endless diversity of material and form, the work of the Coleophora, may also readily escape notice unless specially searched for; the richness and beauty of colouring of the perfect insects, minute though they be, vie with exotic Lepidoptera, and it is a matter of surprise that these little gems have, comparatively speaking, so few collectors.

Botanical knowledge, to a certain degree, is absolutely requisite successfully to collect "Micros," as on or in the plants which afford food to the larvæ many species can alone be obtained in any number. For it is necessary that very many species should be reared from the larvæ, so as not only to secure series of perfect specimens, but to secure proper identification of the species. Some species, although distinct, are so much alike in the perfect stage that, unless we have their history, they cannot be satisfactorily differentiated: the genus *Ornix*, and again the genus *Lithocolletis*, are examples. Among case-bearing larvæ, the cases aid materially in separating species,

* The terms Macro- and Micro-Lepidoptera have of course no scientific value, but are purely colloquial words, and are well understood by entomologists.

and these should always be preserved with the perfect insects which emerged from them.

The months which afford the largest number of species are May, June, July, and August; and the best time in the day to collect is from three o'clock in the afternoon, when many species are on the wing. The crevices in the bark of trees, palings, and fences in sheltered situations should be diligently searched. Blowing gently on the tree-trunks will often dislodge a specimen and enable you to catch it, when otherwise it would be passed over. It should ever be borne in mind that many species, owing probably to their feeble powers of flight, are extremely local; and where we find a species which we require, common, it does not follow that we shall always find it so in that locality. "Make hay while the sun shines" may be rendered, for an entomologist's benefit, "Take your series while you may." When, too, you are searching plants for the larvæ or imagos of a species, do not limit your attention to the large healthily-growing plants; their very robustness points to their exemption from insectile attacks, and it often happens that, while on such a plant your search will be fruitless, on a puny, weakly plant you may find the species you desire in abundance. Glass-bottomed pill-boxes are indispensable for collecting "Micros." If you kill your specimens at once, your hand may not be steady enough to properly pin them. If you pin them properly, they will probably dry before you get them home, if placed in an ordinary pocket-box; or if you place them in a "damp-box," they may arrive at home relaxed enough, but with the long fringes of their wings matted together in a dreadful condition. Box, therefore, your specimens; keep them as cool as possible, and the boxes as steady as you can. Have your empty boxes by themselves, and do not mix them with those which contain specimens. A small net made of very fine silk gauze is best for catching specimens on the wing, but it is too delicate for sweeping herbage from which many species may be obtained. For this latter purpose a bag of fine calico may be substituted.

On cloudy days, when the larger Lepidoptera cannot be found, the collecting of "Micros" may be successfully pursued. Gathering mined leaves, stems, unopened buds, &c., can then be carried on. If the larvæ are transferred to plants growing in pots, covering them with a glass cylinder over one end of which fine gauze or calico has been fastened, the chances are in favour of breeding the perfect insect. Sleeving larvæ of Tortrices on branches of growing trees is a good plan. If, however, these modes are not possible for the collector to adopt, the larvæ may be fed-up in wide-mouthed bottles

having either a cover of very fine wire gauze, or closed by a cork. In this latter case care must be taken to have the food without external moisture. The great thing to be avoided is mould, but it is astonishing how many species may be reared in spite of this enemy. A happy medium between moisture and dryness is the great *desideratum*. On the one hand sufficient moisture to prevent the minute pupæ drying; on the other, not so much moisture as will kill them by the creation of mould. Very many larvæ, especially among the Tortricidæ, if collected full-fed, may with some of their food-plants be simply put into canvas bags and tied up. These will spin up in the folds of the bags, and, as the bags can readily be hung up, a vast number of larvæ may be reared in a small space. Those species which usually pass the winter in the pupa state may readily be forced to emerge in about three weeks or a month, by simply placing them in a warm room, putting at intervals a drop or two of water into the box containing the pupæ. Many people kill "Micros" with ammonia, as described at p. 76, but especial care must be taken to air the pill-boxes afterwards so as not to leave a trace of the ammonia. If the boxes be not quite free, the moths which afterwards may be placed in them will be uneasy, and perhaps spoil themselves by fluttering about. If the killing-bottle be used, the insect should be taken out and pinned directly all motion has ceased. The pins most suitable are Nos. 18 and 20, and black pins should invariably be used. Silver pins should be used for those species likely to become greasy, especially for the rarities. These pins are, however, exceedingly liable to bend. Aluminium is a material which would be admirable for fine pins, if some process could be discovered to make them less brittle. At page 21 of the 28th vol. of the 'Entomologist' (1895), mention is made of a pin of an alloy of nickel made by the firm of Emile Deyrolle of Paris, which gives most satisfactory results. It requires delicate manipulation rightly to pin the "Micros," and unless they be so pinned it is hopeless to try and set many species. The pin should be inserted in the centre of the thorax, but should not slope backwards, as in the larger Lepidoptera; if the pin be thus sloped while pinning a "Micro," there is a chance that the insect will be separated—the hind wings from those in front. Some people place the insects in a fine groove, so as to keep them steady while they are pinned; others steady the specimens between the fore-finger and the thumb of the left hand. Neptriculæ are, perhaps, best pinned when lying on a piece of smooth cloth. The choice of process must be left to the collector. The setting-boards, which should be proportionate to the size of the moths, should be carefully smoothed with fine sand-

paper, or may be covered by thin paper. Before using the boards, all pin-holes should be smoothed-down with, say, an ivory paper-cutter. Bungs, carefully smoothed with sand-paper and having fine grooves, answer admirably for the diminutive species of *Nepticula*, *Lithocolletis*, &c.; the expanse of wing being so slight, all these species may be set with their wings flat. A cat's bristle, fastened by shellac into a small piece of cork through which a pin is passed, forms a very good brace. Some people prefer a long, fine needle as a temporary brace, and use it as follows:—The insect having been pinned in the groove of the setting-cork, the fine needle is pressed obliquely into the cork close to one side of the groove and just a little above the line up to which the front wing will be extended, over which the pin slopes. While with one hand the wings on that side are being arranged, the fine pin is gradually depressed at the head by the other hand with just so much force as is requisite to retain the wings in position by gentle pressure. While the wings are thus held close to the thorax, a small piece of thin glazed paper is pinned over the wings. The fine pin is then transferred to the cork on the other side of the groove, and a similar process gone through. One such fine setting-pin suffices, therefore, for holding down the wings of any number of specimens, one after the other. The fringes of the wings should be carefully smoothed and arranged by passing a fine pin gently under or over them, as circumstances require, and, to assist this operation, it is a good plan to gently blow open the wings of the specimens before putting them in the groove of the setting-boards. The antennæ should be arranged so as to be readily examined, as these are important points for the differentiation of the species. These small moths take but a few hours on the setting-boards to dry; twenty-four hours is usually sufficient in fine weather.

Mr. Stainton's 'Manual,' and his 'History of the Tineina,' are books to which every micro-lepidopterist should have access. While taking advantage of these stores of knowledge at our disposal, we may note, however, the species whose life-history has yet to be definitely written, and seek to elucidate one or more of such.

A CHAPTER ABOUT COLEOPTERA.

By EDWARD NEWMAN.

It is always injudicious to depreciate the work of one's own hands: many apposite, though trite, proverbs might be cited in support of this, and yet a love of truth compels me to acknowledge how incompetent I feel myself to the task I have undertaken, and how much better the task might have been performed by others—for instance, by the indefatigable Power, the most painstaking Janson, the amiable Waterhouse, the enthusiastic Crotch, the philosophic Wollaston ["Fowler" should not be omitted.—A. B. F., 1907], and very many others who are yet rising towards that eminence in the science of Coleopterology which the gentlemen I mention have attained, and which is not now, even if it ever were, an object of my ambition. It was not until every reasonable effort had been made to get a better man, that I reluctantly undertook the task, and that I consented to reiterate those instructions which in my earlier days were supposed to be of service to others still younger than myself in beetlecraft. It is for such as these I write, and should my lucubrations fall into the hands of experts, let them by all means teach their own better way—it is no part of my design to close any avenue to knowledge; and should some profound critic say to me, "Thou hast no practical acquaintance with the modern art of beetle-hunting," and add, in the words of the poet,—

"*Scribere recte sapere est et principium et fons*,"

I would delicately remind such critic of a difficulty he might possibly himself experience even from excess of knowledge—the difficulty of rendering himself intelligible to those less learned than himself: for of a truth, in the words of the same sagacious poet, who seems armed at all points,—

"*Difficile est proprie communia dicere*."

Coleoptera, or beetles, are to be found everywhere, not only from the topmost twigs of the tallest trees to the very surface of the earth on which we tread, but above the trees,—far, far above the tree tops, even in the air itself: far, far below the surface of the earth, even in those deep caverns, dank and dark, which seem so thoroughly designed for avenues of

another world. Only look up into the blue empyrean on a summer's evening, and you will see the swallows and the swifts floating in all manner of curves, and circles, and segments of circles; they are hunting for beetles: those lofty regions of air are their "happy hunting grounds," replete with game, filled with beetles, poetically, but not quite truly, "shard-borne:" they are borne by the wings, for which shards or elytra serve only as a protection. Why the upper regions of air should be filled with little beetles is a question which may perhaps be much easier to ask than to answer; and yet the answer may be found in that migratory impulse which compels a change of residence; the little bettles soaring to regions of which they never formed an idea, or descending in showers on some far distant lands, are but types of the swallow, and the crane, and the locust, which migrate in a more showy and attractive manner,—in a manner, indeed, which forces itself on our notice,—and that phenomenon which appears to human eyes merely a reckless waste of life on Nature's part, is in reality a means by which she disperses, and thus preserves, her multitudinous creatures. Again, we mortals. short-sighted as we are, cannot understand why beetles should be shut up for ever in those dungeon caves, into which no ray of sun-light can ever enter, where eyes are of no use, and where wings would be simply an encumbrance: yet so it is; those wondrous caves have a beetle fauna of their own, eyeless and wingless, and doomed to what we should call an existence as wretched as the most skilful tyrant could devise: it is not so; it is only our philosophy that is at fault; there is no mistake in the arrangement of an Allwise Creator. But it is neither in the boundless realms of air nor deep in the bowels of the earth that the entomologists I now address must seek for beetles. Flowers, leaves, bark and wood of living trees abound in beetles; the bark and wood of dead and dying trees; the carcasses of dead animals: there is no better trap for beetles than a dead crow or a dead mole, or, by the river's side, a dead dog or dead fish; every fungus, living or dying, abounds in beetle life; and so does the dung of animals—of horses, cows, pigs, and sheep. In the granary; in the baker's shop; in the malt-house; in cellars; under faggot-stalks; in the earth at the roots of trees; in gravel-pits and sand-pits; in moss; in mud; in water; under stones; at the roots of grass—everywhere.

Seeing then that beetles are so ubiquitous, there need be no difficulty in collecting them; and the simpler the instruments employed the less trouble will there be in procuring them, and the less expense in keeping them in repair: a walking-stick, an umbrella, and a wide-mouthed phial, are the three great requisites, but each, as we shall see, is susceptible of improve-

ment. However, let us begin at the beginning. Furnished with these three implements, you sally forth into the fields. It is May or June: the hawthorn is covered with bloom; open your umbrella and invert it under the most floriferous bough you can find; you must hold it as close as possible, and under as much blossom as possible, and then you give the bough a smart rap with the walking-stick, and in an instant there decends a shower of white petals and living things, beetles, intermixed with spiders, earwigs, harry-long-legs and caterpillars. Sit down instantly, take the still out-spread umbrella in your lap, take the cork out of your bottle, and, picking up the beetles as fast as you can, transfer them one by one to the bottle. Some will attempt to fly, others to run, and will scramble out of the umbrella if they can, but you must endeavour, by a celerity of manipulation, to restrain their well-intentioned attempts at self-preservation. Bottle everything at first, even *Lagria hirta*, that somewhat soft-bodied, brown-winged gentleman, that falls with every stroke of the walking-stick; bottle even that, and take it home to examine. Next try some other tree or shrub, especially juvenile aspens and abeles; hazels and birches and oaks. Aspens and abeles are particularly fond of throwing up off-shoots or suckers in unexpected places, in roadways, open spaces &c., and some beetles feed exclusively on their young leaves. Many leaf-beetles live entirely on leaves: their eggs are laid on them; their caterpillars are hatched on them; their chrysalids are glued to them; and the beetles themselves are well content to reside on them during the whole of their beetle-existence. I have often seen a young aspen so crowded with green beetles that they almost hid the leaves; just tap it with your walking-stick and see what a shower of gems falls into your umbrella! and so with willow-herb, only that the residents on willow-herb are brilliant blue.

Here then we have taken the first step in beetle-hunting, and now for improving the implements. In the first place, let me invite your attention to the colour of the umbrella; an ordinary gamp is usually made of very sombre colours, dark green or dark brown: now these colours are not well adapted to show off a small brown beetle or a small green beetle, often no bigger than a pin's head; and I therefore recommend a white umbrella, or, if you consider such an implement rather too showy and attractive,—and I am willing to admit that on beetling excursions one need hold out no inducement to outsiders in order to attract their attention,—then a kind of compromise may be made by having your umbrella lined with white calico or some similar material, leaving the exterior in full possession of its usual unassuming colour. I feel desirous

to enforce the axiom that, when on beetling excursions, it is undesirable to take any superfluous steps that may attract attention, for there are few things more trying than the company of those who do not sympathize with your proceedings. The rightly disciplined mind may bear with the remarks of a dozen national school-boys, however uncomplimentary, or even aggravating; but when a stately rector, or some "very clever and scientific" medical man asks, with politely condescending and patronizing air, "What are you doing?" and turns away with deeply injured feelings when you tell him the exact truth, it is hard indeed to bear. One does not like a conversation in which one has exerted his best abilities to please and to give information,—one does not like, I say, such a conversation to be wound up in this fashion: "Young man, the next time a gentleman asks you a civil question, I hope you will return a civil answer: you *may* have been at school, and *may* have learned to read and write, but you were never taught manners." If you had told some glaring untruth—for instance, that the beetles were intended for food or for fishing, your querist would have gone away perfectly satisfied; but as you have told the unobtrusive truth, that they are to be gummed on cardboard, arranged in rows, and labelled with Latin names, he is persuaded you are "poking fun at him," and resents it accordingly.

Next, as regards the stick: I have considered it only as a "threshing machine,"—let us now convert it into a "sweeping machine." "Find out," says Mr. Douglas, in his 'World of Insects,' "a descendant of Tubal Cain, who has ability to work neatly in brass; get him to make a figure Y with brass tube, the trunk two inches and a half long and five-eighths of an inch diameter; and each arm two inches and a quarter long and three-eighths of an inch diameter. Into one of the small tubes put a tightly-fitting cane and bend it until its meets the other small tube and forms a pear-shaped ring. In carrying, this ring may be rolled up so that it will go into your hat; then get a lady-friend to make a bag-net of book-muslin, rather larger than the ring, thirty inches long, and cut so that it shall hang perpendicularly from the handle tapering from the opposite point of the circumference, but rounded at the bottom, not going to a point; round the top of this muslin net must be a band of brown holland into which the cane can slide easily." Slide the net on the cane and fit the two ends of the cane into the two smaller arms of the brass Y, and then fit your walking-stick into the larger tube or trunk of the Y. As soon as these arrangements are complete, and the cane and stick firmly fitted in their respective tubes, you have a sweeping-net of the most convenient size and shape. With this light

and convenient net you can sweep the grass that grows by the road-side everywhere, taking care to avoid the brambles and briars. You have already been astonished at the number and diversity of objects procured by beating: you will, I think, be more astonished when you see "the green myriads of the peopled grass." The only difficulty and drawback to this mode of collecting is the plethora of captures; unless you examine your net continually you will find it half filled with a mass that no labour will disentangle: snails and grasshoppers, spiders and veneer moths, earwigs and beetles, leaves and flowers, will be kneaded together in a hopeless conglomerate; the beetles will suffer the least, happily for them—their case is a hard one.

Still another use for the stick: a second net may be made of the material called cheese-cloth: this may be fashioned into a net like that already described by Mr. Douglas, and with a similar band of brown holland: then procure an iron hoop of a circular form and furnished with a tube or trunk, as in the case of the sweeping-net; into this the stick must be fitted, and you are then furnished with a fishing-net. This again produces a myriad of novelties: every river, every brook, every canal, every pond, every ditch, every puddle, is replete with beetle life, and however great this diversity you will find that each form is familiar to the masters of the science.

Let us next turn our attention to decaying or decayed bark and wood: no sooner has a tree submitted to the irresistible attacks of age, and has thus become incapable of continuing its kind, than Nature enforces her mission of removing it from the face of the earth: wood-boring beetles immediately fall to work, penetrate the bark and the wood, and complete the destruction which old age had begun. Now another implement is required; a chisel or screw-driver may answer the purpose, but it is better to be provided with an instrument made especially for the purpose; a very strong piece of iron wire should be firmly fixed in a handle, and its end should be bent almost at a right angle and ground into a sharp point. With this instrument the decayed bark of any tree may be ripped off, the wood itself torn to pieces, and the beetles which are feeding beneath the bark exposed and picked out.

To beetles is also entrusted the task of removing offensive substances left on the ground and to carry them beneath the surface. This applies to all dead bodies, and especially to the excrement of animals. No sooner is an animal killed than the carrion beetles and burying beetles make it their especial resort: the vulture does not more speedily perceive the death of a camel or a horse in the desert, than does the carrion beetle the demise of a bird, a mole or a mouse: they wing

their way to it by night or by day, and mining into the interior, remain there concealed from sight as long as the unsavoury repast endures, devouring some and burying the rest. Here again the umbrella and the walking-stick may be called to our aid: if a dead crow be found on the surface of the ground, he must be held up by the leg and beaten over the outspread umbrella until the dead has given up its living tenants; some of these are large and beautiful, intensely black and barred with the brightest orange; others are small and apparently insignificant, but all are known and classified, and all valued by the collector, either as rarities or as filling a vacant place in his cabinet, and thus making his series complete. But the excrement of animals is perhaps the most attractive lure for the world of beetles; the droppings of horses and of cows are full of beetles, and everyone knows that these offensive substances constitute the nutriment of plants. Animals leave it on the surface, beetles dig holes in the earth beneath each deposit, and convey it to the roots of plants. I have found that a most efficacious way of collecting dung-beetles is to plunge the droppings into a bucket of water: on stirring up the mixture the beetles will soon be seen floating on the surface, when they can be secured at leisure.

Tufts of grass are always well peopled with beetles; they get down to the very bottom of the stems, and even among the roots: if the ground is light and sandy, these tufts may be shaken out over a sheet of paper, or over the infallible umbrella, or on a smooth road or pathway: in either case the beetles will be seen running in all directions in their anxiety to escape, and may be picked up, one by one, with the greatest ease. If near a ditch or a pond, these tufts may be plunged in the water, and the living inhabitants will very soon be seen rising in air-bubbles to the top and swimming towards the land with all their might, and thus, in the fancied act of self-preservation, rushing as it were into the very jaws of the enemy.

Moss is a great resort of beetles in the winter: whenever you have the opportunity go into the thickest woods, and pulling up the moss by handfuls, cram it into a canvas bag, which you have taken with you for this especial object. Then on a winter's day, when nothing tempts you abroad, shake out your moss, bit by bit, on to a white cloth, and you will soon possess yourself of wonders. It was thus I obtained *Pseudopsis sulcatus*, and *Muiophila muscorum*, and *Boreus hyemalis*, and hosts of Pselaphidæ. Moss is a never-failing source of interest to the Coleopterist.

Then comes the question of how to kill. There are several modes of doing this; all of them very easy. The plan that I adopted for many years was to keep a quantity of chopped-up

laurel-leaves in the bottles that I used for collecting. Another very favourite plan is to stupefy the beetles with a drop of chloroform on cotton-wool; another plan is to bring the beetles home in pill-boxes and drop them into boiling water, when death is instantaneous, and they may afterwards be dried on blotting-paper; but lately Mr. Crotch has propounded a plan which seems likely to supersede all these, inasmuch as it not only kills but preserves in the best possible condition the creatures after they are dead.

"The following method has now been in use some time, and hence has been fairly tested. Its advantages are very great, so that I make no apology for introducing it to the notice of your readers. The first idea of the process is due, as far as I know, to M. de Vuillefroi, who used it with me in Spain, some years ago, with great success. The specimens may be collected in two ways, according to size and the convenience of the collector. The first and best way, for small species, is by putting them into a bottle containing about half an inch of dry pine-sawdust, in which has been previously placed a small piece of cyanide of potassium about as big as a pea: they will then die instantly. Larger species, and small species which do not fly readily may be put into spirits in the ordinary way, but the Staphylinidæ and others generally open their wings in this process. The sawdust should be pine-wood, and sifted free from chips on the one hand and from dust on the other, so as to be of a uniform size. For storing the species thus collected a few tin canisters will be found most convenient; a layer of sawdust is placed at the bottom, and then beetles, and so on alternately to the top. The sawdust used in the tins should be damped (not *wetted*) with a mixture of spirit and one-twentieth part of carbolic acid, which will effectually prevent mould or mites, and will bring the specimens home perfectly fresh and clean. Small species, or specimens from a particular locality, should be wrapped in a piece of rag or tissue paper, with a little sawdust, and the name of the locality. The specimens collected in spirits should be removed as soon as possible (in a few days at farthest), and transferred to sawdust. When the tins are full, some more spirit and carbolic acid should be poured in and the top soldered down: they will then keep for two years at least. The advantages of this method are manifest, especially in the absence of any danger of breakage or leakage; and it is more than probable that a similar plan might be employed with reptiles, fishes, &c., but for these chloride of zinc suggests itself as the most likely agent to be of service. As the insects do not become rotten by the above process, it is sometimes not so easy to set their legs

in the peculiar manner in vogue in this country, but they will have, as a set-off, the advantage of being thoroughly fit for study. When by any chance spirit cannot be obtained, they will keep perfectly in dry sawdust, if the specimens are dried in the air for a few hours first; all that is necessary afterwards being to relax them in the sawdust instead of removing them from it. Jars or wide-mouthed pickle bottles may of course be used instead of tins, and are more air-tight, but liable to break."

That eminent and most excellent entomologist, Mr. E. W. Janson, endorses Mr. Crotch's recommendation, and adds a few hints on the subject of collecting beetles abroad, as follows:—

"The sawdust plan, now almost universally adopted by collectors, I can recommend both on account of its simplicity and efficiency. The sawdust should be that of some white or yellow wood without colouring matter—pine is perhaps the best; it should be sifted over fine muslin, and the dust and minute particles rejected. In collecting, wide-mouthed bottles should be used; these should be about one-fourth filled with dry sawdust, adding beneath a piece of cyanide of potassium of the size of a large pea or haricot bean. On reaching home after collecting, the contents of the collecting bottles should be shaken out on to a large sheet of paper, and the insects transferred to the stock-bottle or jar, and the cyanide and sawdust returned to the collecting bottles for future use. Any description of wide-mouthed bottles, such as pickle-jars, may be used as stock-bottles; they should, however, have tightly-fitting corks or bungs. Before putting the insects collected into the stock-bottle, throw into it a quarter of an inch thick of sawdust, *slightly damped*, not *moistened*, with a mixture made of alcohol (methylated spirit will answer admirably; brandy or strong whisky, if unsweetened, will suffice, but sweetened gin and rum must be avoided), or, still better, benzine or benzoline, and carbolic or phenic acid. These should be mixed in the proportions of nineteen parts of alcohol or benzine and one part of carbolic acid. On the sawdust damped with this mixture place a layer of insects, over them a second stratum of damped sawdust, then a second layer of insects, and so on alternately until the stock-bottle or jar is filled: take care that it is always kept well closed. When it is filled it may be packed with any other objects in sawdust, hay, moss, or any other elastic substance, and forwarded to its destination."

Lastly, there are two modes of preparing beetles for the cabinet: these are technically called "pinning" and "carding"; in either case the wings and wing-cases are allowed to remain

in their usual position, quietly closed on their backs; the legs and antennæ, on the contrary, are carefully arranged in the manner supposed to be natural when the insect is crawling. In pinning a beetle its head should be placed on the setting-board away from the operator, and the pin passed through the left elytron very near the shoulder; not that the exact position of the pin in this respect is very important, but that uniformity adds greatly to the beauty, value, and neatness of a collection; and if one beetle be pinned through the thorax, another through the right elytron, a third through the left elytron, and a fourth through the scutellum, the effect is extremely inelegant and offensive to the lover of order. It seems almost a matter of necessity that the smaller beetles should be carded: a pin, even the finest, completely destroys the symmetry of their shape, always breaks one of the elytra, and often carries away one or more of the legs, as well as forcing out of its place a large portion of the under surface. The plan to be adopted to avoid this difficulty is to prepare a thin solution of gum-tragacanth and the purest colourless gum-arabic in equal proportion, and a small quantity of corrosive sublimate intermixed: this mixture is spread over the surface of the card, and the beetle laid thereon, and its limbs carefully arranged with a camel's-hair pencil, care being taken that the limbs are free from all rigidity and capable of being moved with the slightest touch of the pencil—a state that can be ensured, by immersion in boiling water, even years after death.

HYMENOPTERA.

Directions.—For the preservation of the larger Hymenoptera or Aculeata (ants, bees, wasps, &c.) the late Mr. F. Smith gave the following recommendations:—"I capture my insects with a bag-net (when I consider a net necessary, because I really capture three-fourths with my fingers) made of the very finest white net that is manufactured, twenty-two meshes to the inch: this is only to be procured at a few of the best shops in London. When collecting, I carry a good supply of the best block pill-boxes of different sizes, packed in a flat tin case that fits a satchel; this prevents the boxes from being crushed in travelling to my hunting-ground. On arriving I transfer the boxes to the right-hand pocket of my coat.

When I capture an insect in my net I select a proper-sized box, take off the lid, and secure the insect in it against the side of the net; then, with a little manipulation, I put on the lid. The insect is now quite uninjured, with not a hair on its body ruffled. Each capture I thus secure in a separate box. These boxes I put into the left-hand pocket of my coat; and when I have filled a number, or have taken some great rarity, I put them back into the tin case; if a rarity, I frequently put the box in which I first secured it into one a size larger. Before starting on an excursion I examine all my boxes, to be sure that the lids fit closely; if they do not, a strip of paper pasted round the rims makes them secure.

On arriving home I kill the insects: first the largest boxes, raising the lids on one side, so as to leave a very narrow opening to admit the fumes of sulphur; I then pile the boxes one upon another in a pyramidal heap, and over the pile I place a bell-shaped glass, usually six inches in diameter, but the size will vary according to the number of boxes; I then take a little powdered sulphur on the end of a thin piece of flat wood (a match, in fact), light the sulphur, and place it beneath the bell-glass,—this process will sometimes require repeating once or twice, until the sulphur will no longer burn beneath the glass; it is then sufficiently charged. In this condition I leave it for about half an hour. I then empty the contents of the pile of boxes into two or three larger ones, recharge the bell-glass, under which I place the boxes of insects, and leave them until the following morning; the insects will then be in a proper condition for setting. Every insect will be found in the most perfect condition: pubescent ones, such as humble-bees, have not a hair disturbed, and they can be pinned without any liquid *oozing out of the thorax* and matting the pubescence.

My method of setting and drying specimens is as follows:— For the latter process I use a drying cage, with door and back covered with net (perforated zinc would answer as well, if not better); the cage has several setting-boards resting upon slips of wood, and corked on one side, the cork being half an inch thick, thus allowing the insects to be pinned at a proper height. The setting process is very easy and simple: having run a pin through the thorax, slightly before the middle of its disc, I mount it on to the setting-board, running the pin into the cork, until the under side of the thorax very nearly touches the cork; the next thing to be done is to arrange the legs in a natural position by the aid of fine pliers and setting-needles, securing the limbs in position, when necessary, with pins; on each side of the specimen I place a table for expanding the wings upon; this is simply a strip of good, stout Bristol-board, that is, stout card.

These tables must be of various sizes, and used according to the size of the wings of the insect. Having fixed the tables firmly, I place the wings upon them with a setting-needle, and having by a little manipulation, if necessary, hooked the wings together, push them forwards into the required position, holding them there with a needle, until, with a brace made of a strip of card shorter than the table, and pierced through at one end with a pin, the wings are secured in their proper position. The last process is to arrange the antennæ. This can sometimes be done by placing them on the end of the table on which the wings are spread; but, in the majority of cases, it must be done with pins. The time necessary for insects to remain on the setting-boards depends upon a variety of circumstances. I am here alluding only to insects recently caught. In the height of summer, if dry and hot, a fortnight may do for small or slender insects, but I seldon remove any so soon. Bombi should, even in hot, dry weather, remain at least a month, and at other times must be left five or six weeks, or the wings will be apt, in damp weather, to fall out of position."

Of the ichneumons, sawflies, and smaller Hymenoptera generally, Messrs. Bridgman and Fitch say:—"Since it is extremely difficult to identify these, whose specific characteristics are often very minute or obscure, unless some care has been taken in their killing and setting, the following hints as to the best methods to pursue are entered into rather fully. First, as regards killing, there is nothing equal to the fumes of burning sulphur; this permanently fixes the red and yellow with which so many species are marked. Cyanide of potassium changes these colours, more especially the yellows, which it turns into a fine red, and consequently spoils the specimens. This, as well as chloroform, also renders them so rigid that it is with

difficulty that the limbs can be displayed. If the insects are killed with sulphur and put into a zinc box, with a little damp sand or a piece of blotting-paper moistened with water to which a drop or two of carbolic acid has been added (of course the insects are not to be laid on the moisture, but put in a wide-mouthed bottle or other convenient receptacle), and left for two or three days, they will be in splendid condition for setting; they may even be kept there for a week, provided they be kept cool and not allowed to dry.

There are two methods of mounting, each of which has its advantages and disadvantages; no doubt carding is the better plan, because the insects are less liable to be injured in examination and transit than if they were pinned. Should they be carded it is better to cut a V-shaped piece out of the card, and place the head and shoulders over the aperture. Thus made, the piece can very easily and neatly be cut out with a pair of punching-pliers, such as are used by the railway officials to snip the tickets; this allows the examination of the face and under part of the front legs. It is a good plan to leave one wing free, as by this means the side of the thorax and coxæ are exposed, or, better still, to card one specimen on its back when no doubt exists as to the specimens belonging to the same species. In pinning carded specimens a rather long strong pin is a great advantage (No 14 is a good pin for this purpose).

General directions for neat and successful carding are fully given in the next paragraph. If the insects are to be pinned always use a long pin; it is better to have the pin too long than too short, as with the latter many insects must accidentally become damaged whilst handling them. No 7 was the pin generally used by the late Mr. Frederick Smith, and is a very useful pin, but for some even a larger one might be used with advantage. But whatever size is used the insect should be placed well up the pin, so that the legs may not be injured when stuck into the store-box or cabinet, and, besides, it allows room for a label to be put on the pin beneath the insect. For setting, nothing is better than two thicknesses of cork fastened on a flat board, and covered with white paper. The legs can then be extended, and the wings held in position by small card braces; if the insects have been kept a day or two in the damp box no difficulty need be experienced with the wings; should they not fall at once into their places they may easily be made to do so by pressing the base of the metathorax gently with the handle of the setting-needle (which may be cut wedge-shaped for the purpose) towards the head, when the wings will immediately fly forwards and downwards."

Dr. E. Capron's directions for carding, useful in the preserva-

tion of the smaller species, is as follows:—"It is above all things necessary to determine the names of the smaller species of Hymenoptera, that they should be set in such a manner that all the important characters should be plainly visible, and that the thorax should not be entirely destroyed by a pin as large as itself, which is generally the condition in which I receive specimens from correspondents. If killed by the ordinary methods, such as cyanide of potassium, laurel, or chloroform, the insects almost always die with the wings folded vertically and the legs contracted, and so rigid are the muscles of this class, that, unlike Lepidoptera, no amount of relaxing can be effected by moisture, and the insect is generally useless. After many trials I have found the plan I adopt so successful that I think it is worthy the attention of those who intend to study this most interesting group. In the first place, however, it is necessary to bring the insect home alive, and not damaged by its capture; nothing spoils the appearance of a fine ichneumon so much as a missing leg or antenna. These insects are so active in a net that they will often give you the slip before you are aware of it and escape altogether. My plan is as follows:—

"I take with me a pocketful of medium-size chip boxes, or rather large pill-boxes, and a wide-mouthed bottle with a large cork, charged moderately with cyanide of potassium. I place this over the insect in the net, and hold my hand on the top (the net being between) until the insect is just stupefied but not dead. With the smaller ones this occurs almost at once. I then remove it, and examine it with a lens to see if it is worth saving; if it is, I transfer it to one of the boxes.

By the time I reach home the insect will be lively as ever, and I kill it in the following manner: I take a large white basin and fill it with quite boiling water. When it has cooled a few degrees I take each box and give it a tap to send the insect to the bottom, and then suddenly take the lid off and invert it over the water, again tapping the bottom to send the insect out. In nine cases out of ten the insect falls on to the hot water with its wings expanded horizontally, and the legs stretched out. It should not be left long on the hot water, but almost immediately be lifted out with a camel's-hair brush, and placed into another vessel of cold water.

When all are thus killed I take a cup of spirits of wine—the *spiritus rectificatus* of the Pharmacopœia,—and not methylated, as this is apt to be greasy, and unpleasant to the taste and smell. I immerse each insect in it, and, placing under them an ordinary glass microscopic slide, I lift them out carefully, the insect being on its back. I then brush out the legs, wings, and antennæ, absorb the superfluous spirit by the brush,

occasionally drying the latter on blotting-paper or by the mouth, and put it aside to dry. This is accomplished in a few minutes, and the insect can then be easily removed from the slide in the most excellent condition for the setting process, which I will now proceed to describe.

"The materials required are some small squares of stout six- or eight-sheet Bristol-board, such as is used for mounting drawings, and the following solution: gum acacia, one ounce; white sugar, half an ounce; water, two ounces. It should be thoroughly dissolved, and is best made some time, and kept until it is very thick and flows with difficulty. The insect being ready, a rather thick line of gum should be placed on the cardboard about the length of the whole insect, and as wide as the body. The insect should be then lifted on to it, taking great care not to touch the wings with the gum. The head should be well into the gum, and be first raised and placed into position with a needle inserted into the other end of the stick which holds the brush. Then the two front legs should be placed in their right position, and fastened securely by the brush and gum. The wings may then be carefully placed with the wetted brush, and, lastly, the two posterior pairs of legs and the antennæ. The gum should be used freely, as it can all be removed afterwards.

"The insect should then be placed on one side until perfectly dry; indeed, I leave mine thus prepared until the winter gives me time for their examination. When thus required I place a large drop of water on the insect, and when the gum is well dissolved I again remove it off the board to a cup of clear water, from thence into the spirit, and this time dry it with its back upwards on the glass slide. It may then be removed quite stiff and well-set, and mounted on a piece of thin card with only a slight dot of gum under the thorax.

"Though apparently troublesome, the process becomes easy enough after a little practice. I have often mounted thirty or forty specimens in a couple of hours, and have succeeded in the smallest Chalcids, and even the most difficult and unruly Cynipidæ. The reason for adding the sugar to the gum is to make it more quickly soluble in water, and it also dries quicker and firmer. Great care should be taken to wash off the gum thoroughly in the last washing, as otherwise the wings might stick to the glass slide. I have tried the same plan most successfully with the Tenthredinidæ, and also with Coleoptera, and even kill bees in the same manner. It is certainly the best way of obtaining perfect relaxation after death."

BREEDING OF GALL-FLIES.

By E. A. FITCH.

The flies may be bred from some galls very readily by merely placing them into a chip or any other box, and letting them bide their time, but others require more attention and care, *e.g.*, the succulent galls of *baccarum* (the currant oak-gall), *curvator* (the kidney oak-gall), *terminalis* (the common oak-apple), *megaptera* (the oak-trunk gall), and many others, which, if collected in damp weather, or are slightly immature and full of sap, are almost sure to mould; in such cases the better way is to leave them in the room for a day before putting them away, and then to remove their covering every day for a short time. I have found the thistle-gall of *Urophora cardui* very troublesome.

The plan which recommends itself, I think, before all others is one used, I believe, extensively by the breeders of Micro-Lepidoptera, and which answers for galls admirably; that is, to procure some common gallipots and rub them down, so as to have a smooth edge, on which a piece of good glass will fit closely, and in this receptacle, which will be almost air-tight, the galls may be kept; it is very convenient also for examination, as the presence of mould or the exit of insects may be seen at once, and the escape of the flies, if the pot be ground smooth, will be impossible, which is not always the case with various boxes; of course, anything may be substituted for the gallipot, if it has a smooth edge and flat top. Care should be taken to have the receptacle very dry, and not to cause the condensation of vapour within by leaving it in the sun.

When we are breeding from galls produced by sawflies (Tenthredinidæ), which occur almost exclusively on various species of willows, or some gall-gnats (Cecidomyidæ), we must have a small quantity of baked earth in the bottom of the jar, as their transformations are subterranean. Great care is necessary in breeding the various insects from galls, because the habits of some of the Cynipidæ, Chalcididæ, Ichneumonidæ, &c.,—all of which are freely bred from galls,—are such that they may very easily be introduced into the gallipot, and on their emergence of course are labelled as inhabitants of the galls themselves: for instance, how easy to introduce some half-dozen aphides (plant-lice), which probably each contain an *allotria* (Cynipidæ) or *aphidius* (Ichneumonidæ);

then, again, there are the numerous Chalcids and Ichneumons, which are parasitic on leaf-mining Diptera, Hymenoptera, and Lepidoptera; the leaf-miners themselves are also very liable to cause confusion; and when we remember that Mr. Walker bred examples of seventy-five different species (hundreds of specimens of some) from one species of gall in one year,—and these belonging to *seven* orders of insects, besides Arachnidæ and Acari,—it is evident the breeder of gall-flies (by this I mean, here, the different insects inhabiting galls) will find quite enough to occupy his attention without the interlopers.

After we breed the insects, and when we perhaps see the glasses of some twenty gallipots swarming with flies, we want to know how to preserve them well and quickly: this will best be accomplished by procuring a small basin of boiling water, and by holding the glass some little distance above, and giving it a tap, the greater part of the insects will fall or jump into the water with their wings and legs extended; then collect them on small pieces of paper—thick blotting I use—and pull their antennæ, wings, legs, &c., out, as best suited for examination, and so leave them for a day, when the dried insects will fly off the paper at the least touch from a small knife or even pin; they may then be arranged on cut pieces of cardboard (not too thick) with gum-tragacanth, and so pinned, —separate species on separate slips; this is not much trouble, as the insects may be killed and set quickly, and gummed of an evening or at any leisure time.

One word of advice and caution: label everything very carefully; for breeding purposes only use the galls themselves, —no leaves, no twigs, no anything; in killing and setting be very careful not to mix specimens and species from different galls. This must all be attended to, in order to solve some of the interesting problems connected with parasitism and galls.

In special cases the gall may be kept by preserving the twig or plant in water till it comes to maturity and the larvæ are full fed; then detach the gall. From the common oak-spangles (*Neuroterus lenticularis*), which I obtained in the autumn and winter from the trees, I could never breed the *Neuroterus*, till I collected galls from the ground at the foot of oaks in January and February, and so bred the gall-maker freely; and that is what must be done with this species and *fumipennis;* it does not so much matter with the pretty little *numismatis* (silky button-gall).

Galls should not be thrown away when the emergence of one series of insects is complete, as some will have tenants for a twelvemonth; the gall-makers and various inquilines (dwellers in galls) and parasites having various and separate times of appearance.

APPENDIX

ON

ENTOMOLOGICAL TECHNIQUE

AND THE

HABITAT, PRESERVATION AND COLLECTION

OF THE

VARIOUS ORDERS OF INSECTS.

APPENDIX.

BY

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INTRODUCTION.

EACH year entomology becomes an increasingly specialised science. This appendix has been written with a view to supplementing the matter already contained in this excellent little book. Also, it is hoped that the information given will, with regard to the lesser known insects, be the means of promoting interest in these groups. The author thinks that more amateur entomologists, instead of merely pinning insects, should make use of dissections and simple microscopical mounts as a means of acquiring knowledge. An expensive microscope is not an absolute necessity, since much good work can be done with the aid of a good lens. Owing to the limited space allotted to this Appendix, and the wideness of the subject of entomological technique, it has been somewhat difficult to make a selection; this the author trusts will afford satisfaction. The author would like to thank Professor H. Maxwell Lefroy for some very helpful suggestions.

L. N. S.

October, 1923.

VARIOUS METHODS OF PINNING AND STAGING INSECTS.

Figs. 1–5 show, in diagrammatic form, several ways of mounting minute pinned insects. Fig. 1 is included so as to explain to some extent the remaining diagrams (Figs. 2, 3, 4, 5). The insect has in all cases been represented by a rectangle with three divisions to represent the head, thorax and abdomen; the head is dotted, the thorax black and the abdomen shaded with vertical lines. No indication is given of legs, wings or antennæ, in order to render the meaning

clear. Seen end view, the insect is represented as being curved dorsally, flat on the ventral surface.

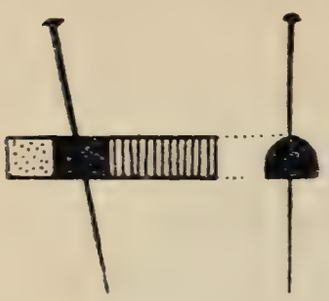


Fig. 1.—An insect pinned through the thorax in the usual way. The pin should slope slightly forwards.

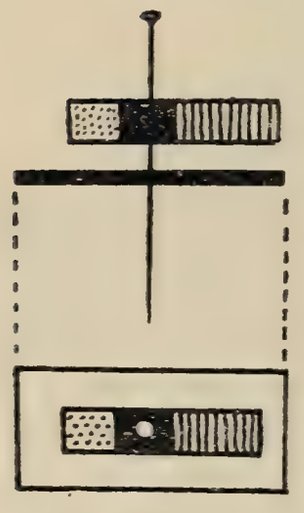


Fig. 2.—This shows the manner in which support may be given to the legs of an insect by pushing a card up the pin from below. If desired, celluloid may be substituted for card; the undersurface of the insect may then be examined.

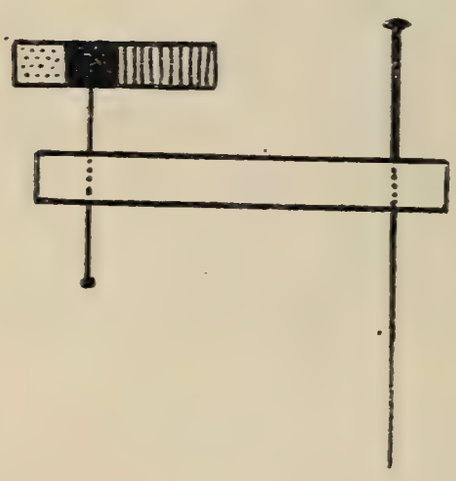


Fig. 3.—This demonstrates the method of mounting an insect by pinning it from below through pith. It will be noticed that the pin does not project through the thorax of the insect. The pith is in turn mounted on a larger pin. Celluloid or card may be used in place of pith, but the latter is by far the most serviceable.

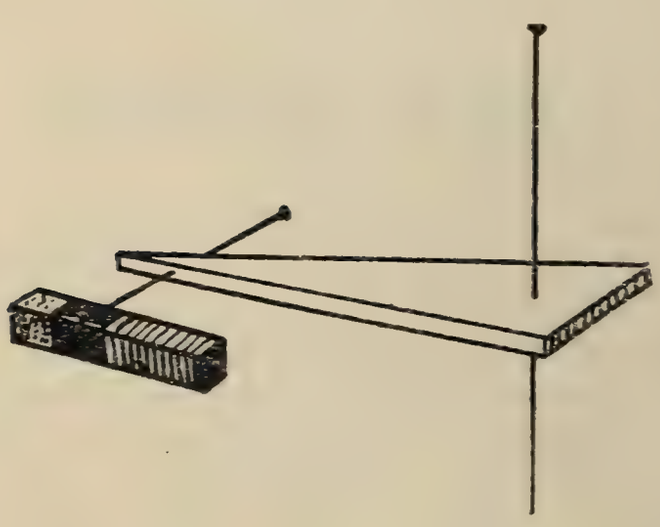
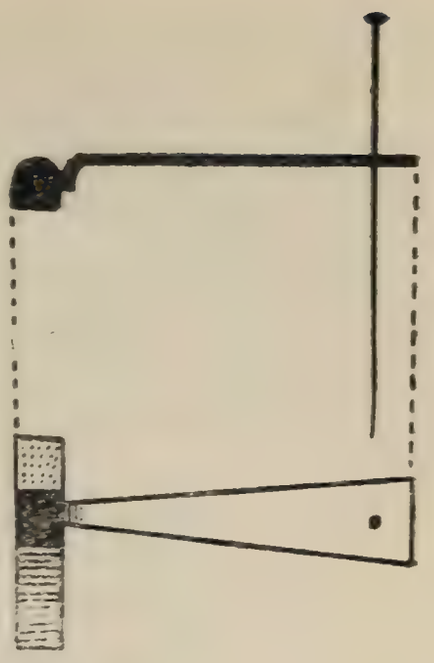


Fig. 4 illustrates the method of mounting an insect on a fine pin which has been thrust between the second and third thicknesses of a triangle of 4-sheet Bristol board, the card afterwards being mounted on a larger pin. It will be found very suitable for small *Diptera*.

Fig. 5 illustrates a method which is very well suited to the smaller *Coleoptera* and *Rhynchota*. A triangle is cut from a piece of Bristol board and the tip is bent down at right-angles. The insect is attached, by means of gum tragacanth, to the small bent portion of the triangle. It is the side of the insect which is gummed, thus leaving the upper and lower surfaces and one side free for purposes of examination.



USE OF NAPHTHALENE FOR STORE-BOXES.

Williston, in his 'North American Diptera,' mentions a very simple method of keeping naphthalene in store-boxes. The ordinary naphthalene balls are most suitable. The heads of ordinary pins, when heated red-hot, may be thrust into the naphthalene balls, which, when quite solidified, will be firmly mounted.

USE OF BEECHWOOD CREOSOTE IN THE TROPICS.

In the tropics, beechwood creosote should be painted round the sides of the store-boxes. It is by far the most satisfactory method of protecting collections from mites and moulds, under the unfavourable conditions found in hot countries.

MOUNTING IN "THYMOPLAS."

This method of mounting insects was devised by Dr. A. Moore; a full account of it will be found in 'The Journal of Tropical Medicine and Hygiene' for November, 1919. Essentially the method is as follows:—

Each insect is enclosed in a cell composed of two slips of celluloid; between the two slips is a circle of "Thymoplas," the slips being pressed together. The insect is then gripped by the celluloid slips and is, in addition, completely cut off from the outside air. The "Thymoplas" contains a preservative, and so the insect is protected from moulds, damp and other agents which make a speciality of destroying collections. A piece of gummed paper is then

bound round each end of the cell and full particulars of the insect may be written here.

"Thymoplas" consists of a mixture of "Plasticine" and thymol; it has been put upon the market, together with all the necessary accessory materials, and may be obtained from dealers.

This method of mounting will be found of great value in many ways. While not recommended for such insects as Lepidoptera, it is difficult to find any better method of preserving the class of specimen indicated in the list given below:

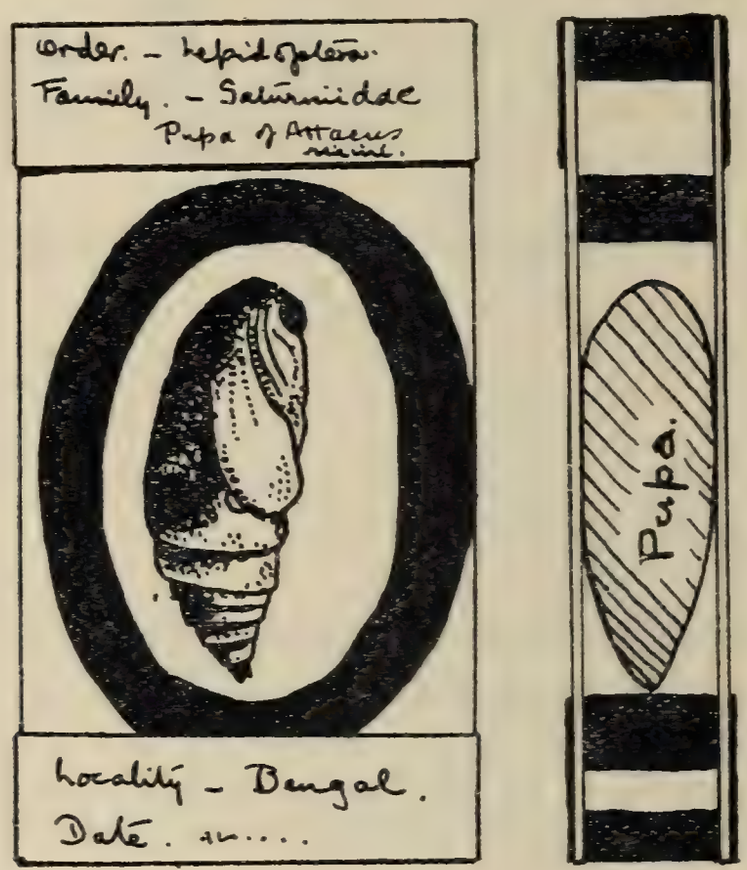


Fig. 6.

Eggs, egg-masses, cocoons, pupæ, strongly chitinised larvæ, many *Diptera*, *Coleoptera*, insect galls, portions of the nests of *Hymenoptera*, and similar objects.

The insects should in all cases be killed, but it is not necessary that they should be dry before mounting them. Fig. 6 illustrates the process.

"FOUR-STRAP SETTING."

A very useful method of setting, when no setting boards are available, is that known as "four-strap setting." Knaggs has described the procedure in 'Science Gossip' (1875). Fig. 7 illustrates the method quite clearly. Two large card braces, or "straps," are placed in such a position

that, when the insect is placed over them, the middle of the costæ will rest on them. A second pair of straps is applied to the wings and on the opposite side of the insect to the first pair. The natural springiness of the costæ will be found sufficient to retain the wings in position. A third pair of straps may with advantage be placed over the tips of the wings. The process may be carried out on a piece of soft wood, cork or linoleum.

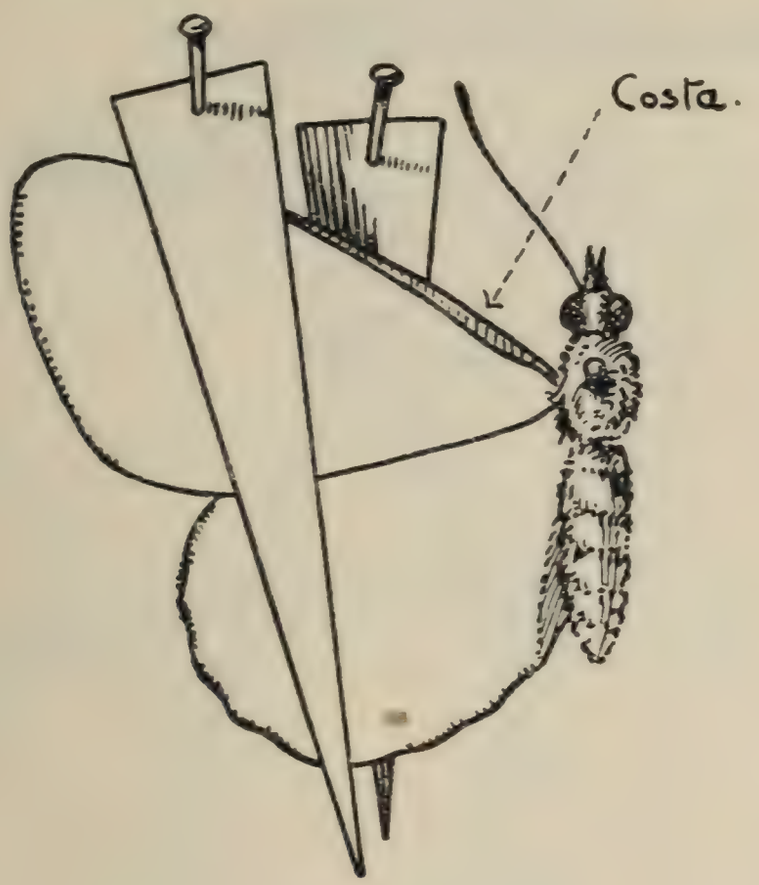


Fig. 7.

COLLECTING INTO SPIRIT.

A good procedure, by means of which small insects may be easily collected, is that known as the "spirit-brush" method. It is extremely simple and is as follows :—

A number of tubes, half-full of spirit, is carried by the collector. A medium sized camel-hair brush is wetted with the spirit, and the insects picked up adhering to the brush. The brush is then dipped into the spirit in the tube, when the insect will be released and fall to the bottom. Insects in this way may be collected into formalin, Bouin, Carnoy or other fixing fluids, in addition to spirit.

It may conveniently be mentioned here that the most suitable system for keeping small insects in spirit is to employ small corked tubes about one-eighth inch in diameter

and one and a quarter inches in length. The insects and spirit (70 per cent. alcohol is best) are placed in them, together with a small label bearing the name in pencil or waterproof Indian ink. A number of the tubes may then be stored in a larger tube, again containing spirit, in order to prevent evaporation.

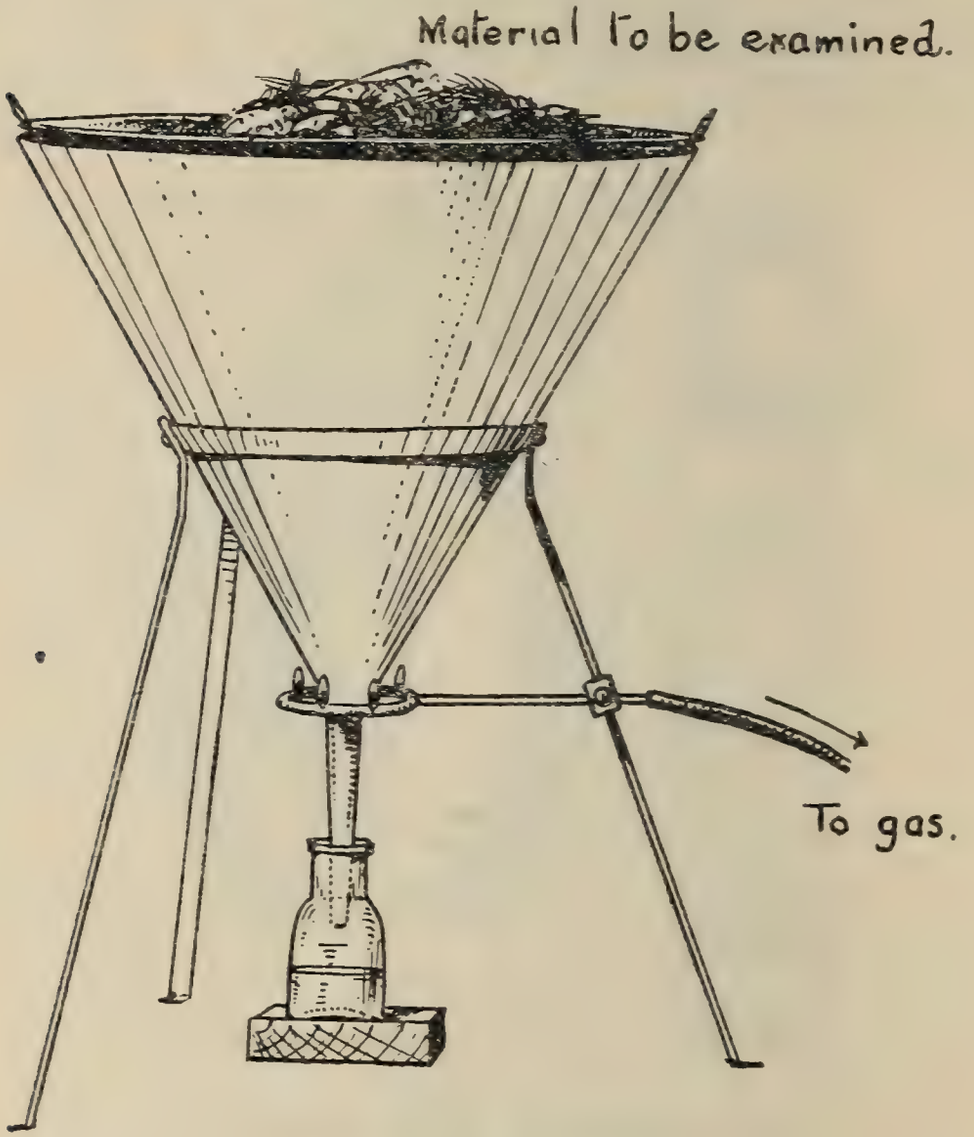


Fig. 8.

THE COLLECTION OF EXTERNAL PARASITES OF ANIMALS AND BIRDS.

The animal or bird, after it has been shot, should be placed in a box while it is still warm. A little chloroform should be poured on a piece of cotton-wool and placed in the box; all the parasites will then drop off and fall to the bottom of the box.

BERLESE FUNNEL.

The account of the Berlese funnel which is most convenient to refer to is that given by C. B. Williams in the

'Entomologist' for October, 1913. The facts here given are taken from the above-mentioned paper.

The Berlese funnel consists of a double-walled metal funnel, about 18 in. in diameter. A detachable fine mesh sieve fits in the top; the lower end of the funnel is drawn out into a tube. The space between the two walls of the

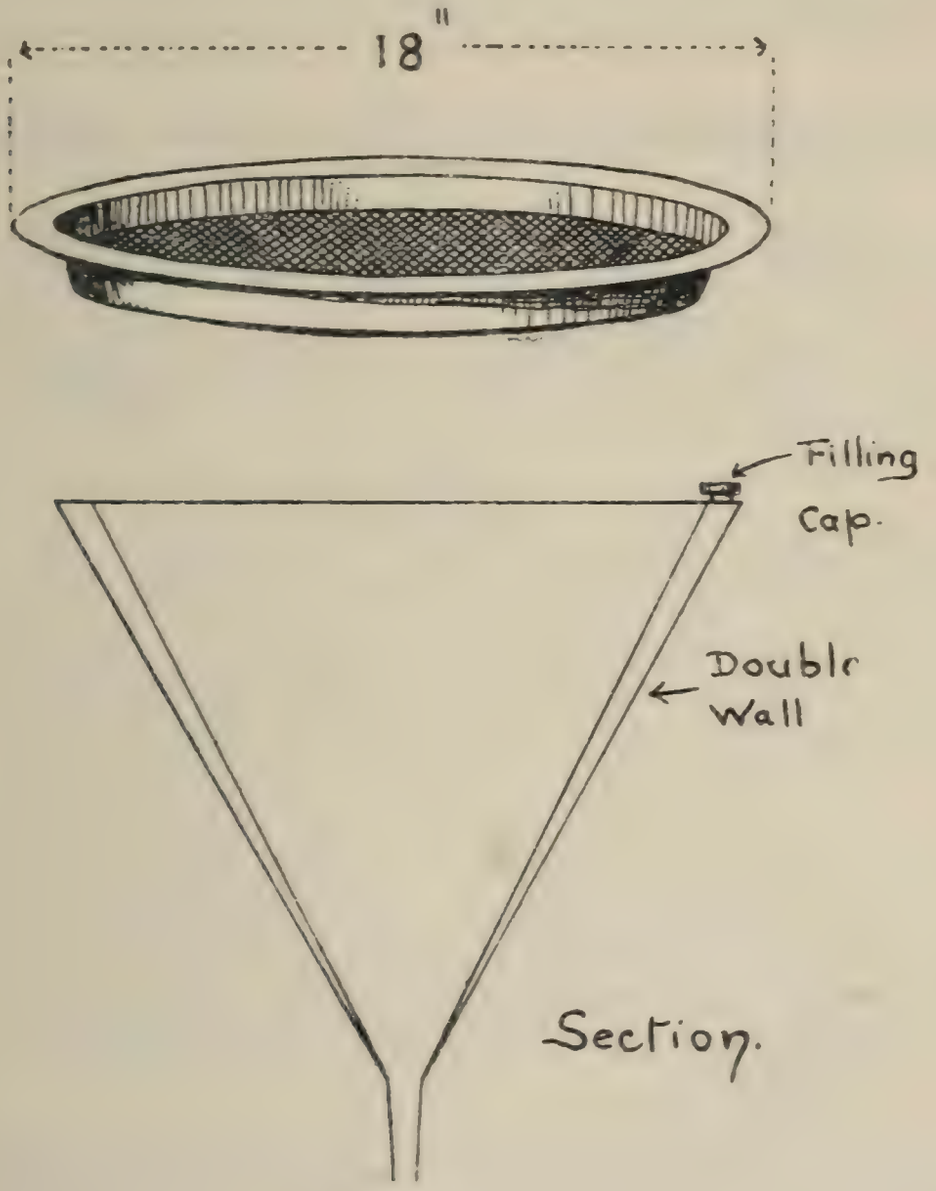


Fig. 9.

funnel is nearly filled with water, the temperature being maintained at about 105°–110° F. by means of a ring burner, which heats the lower part of the funnel.

The moss, dried leaves, grass or other material is placed in the sieve; it should be broken up if necessary. The various small insects and other minute animals present in the material move towards the warmth and away from the light; they pass through the sieve and fall down the funnel and through the tube into a bottle placed to receive

them. The bottle should contain 70 per cent. alcohol or any fixing fluid, but water may be used if they are required alive.

Apart from insects the following may be obtained :— Woodlice, Spiders, Chelifers, Mites and *Myriapoda*. The piece of apparatus described above was invented by Berlese, in Italy. Figs. 8 and 9, which are adapted from the account by C. B. Williams, will make the construction of the funnel quite clear.

THE COLLECTION OF THE VARIOUS ORDERS OF INSECTS.

The 26 orders of insects are here taken separately, and rough instructions given for their collection and preservation ; also, in some of the lesser known groups, where they are to be found. Here it may be stated that larvæ, in all the groups, should be fixed in Carnoy or Bouin, and preserved in spirit.

1. PROTURA.

Habitat.—Under stones, in moss or peat, beneath the bark of trees.

Collection.—A quantity of the above materials should be collected and the insects separated by means of a Berlese funnel. (See page 128.)

Preservation.—*Protura* may be kept in small tubes, being fixed and preserved in spirit. An even better method is to make microscopical mounts. The specimens, after dehydration, should be cleared in xylol and mounted in xylol-balsam. "Euparal" mounting gives good results with small *Collembola*, and equally clear mounts should be obtained from *Protura*.

2. THYSANURA.—Bristle-tails, Fire-brats and Silver-fish.

Habitat.—In soil, peat, moss, and decaying vegetable matter. Some are peculiar to houses ; a few species are found on rocks by the sea.

Collection.—By the spirit-brush method ; are best collected into Carnoy or Bouin, and later transferred to spirit. Small species are obtained with the Berlese funnel.

Preservation.—Owing to their soft nature, they are best mounted microscopically. Small species (as *Campodea staphylinus*) may be cleared in xylol and mounted in "Euparal." The larger genera (as *Machilis*, *Lepisma*), are better cleared in potash. In the microscopic mounting it is advisable that several methods be applied to each

species; one type of mount will show certain characters, other features will appear more clearly with a different method of mounting. These insects may be preserved in spirit, if it is so desired, with or without fixation.

3. COLLEMBOLA.—Springtails.

Habitat.—*Collembola* are common in most damp situations. They are found in loose earth, dead leaves, and beneath bark; some are aquatic, while others are found in ants' nests.

Collection.—Small species may be discovered by means of the Berlese funnel, but for collecting the larger *Collembola* the best method is by means of a spirit brush. They should be collected either into Carnoy or Bouin, or into spirit.

Preservation.—Microscopic mounts, or in spirit, with or without fixation.

4. PLECOPTERA.—Stone-flies.

Habitat.—In the neighbourhood of water.

Collection.—Most easily boxed or caught with a net.

Preservation.—*Plecoptera* may be pinned or carded quite satisfactorily, but a number should be preserved in spirit, since dry specimens are rather liable to shrivel. *Plecoptera* are pinned through the thorax; some specimens should be kept with unspread wings.

5. EPHEMEROPTERA.—May-flies.

Habitat.—Confined to the vicinity of water.

Collection.—Mayflies are among the most easily damaged insects. Often the only possible method of obtaining them is by netting, but wherever possible boxing should be resorted to. They are best killed in chloroform.

Preservation.—Since May flies shrivel very easily, pinned specimens are of little value except for showing the venation of the wings. The best method of preservation is perhaps in spirit, but mounting in "Thymoplas" is very satisfactory for this group of insects. Specimens of the imago and sub-imago should be collected.

6. ODONATA.—Dragonflies or "Horse-stingers."

Habitat.—Near water and in clearings in woods and forests.

Collection.—Dragonflies are difficult to catch on the wing, and are most easily taken with a net when settling. A good method, which is not so barbarous as it would at first appear, is to catch them by means of a light branch. If a branch about 4 feet long, well provided with twigs and

leaves, be cut, it will be found quite possible to stun the insect without causing any part of it to be broken.

Preservation.—Unfortunately Dragonflies soon lose their brilliant coloration, and it is therefore advisable if the collector has any skill in drawing, that he should make a water-colour sketch of the insect before the colours have faded. Since detail may be obtained from the insect, close attention need be given only to the colour. Such slight drawing will greatly increase the value and interest of the collection. It has also been stated that if the insects are kept alive for two or three days without food, before killing, the colours will not fade so quickly. Dragonflies may also be treated by removing the contents of the abdomen through a ventral incision; the colours will then keep fairly well.

7. EMBIOPTERA.

Habitat.—Gregarious, living in silken tunnels in damp situations. No British species.

Preservation.—*Embioptera* should be pinned or carded; in addition, a number should be preserved in spirit, prouerly fixed.

8. ORTHOPTERA.—Cockroaches, Mantids, Stick-insects and Grasshoppers.

Habitat.—Widely distributed and out of doors. Several of the families of *Orthoptera* have no British representatives.

Collection.—The young stages, or nymphs, are best collected in spirit. Grasshoppers will be caught most frequently in the sweeping net; to take some species a beating-tray will be found essential. Grasshoppers travel very well in paper.

Preservation.—The adult insects should be pinned. A card pushed up the pin from the under side will support the hind legs, which are liable to become detached. It is advisable that some examples of each species should have the wings, on at least one side, set out. All *Orthoptera* are pinned through the thorax, with the exception of Stick-insects, which should be carded.

9. ISOPTERA.—White ants or Termites.

Habitat.—Tropical and sub-tropical. Social insects living in concealed nests or large mounds.

Preservation.—Termites are seldom highly chitinised, and do not dry very well. Some of the winged individuals may be pinned through the thorax and dry fairly success-

fully. The majority, however, should be fixed in Carnoy and preserved in spirit. "Soldiers" keep very well in "Thymoplas." "Queens," when fully distended with eggs, should be fixed in Carnoy and preserved in spirit, or they may be preserved direct in formalin.

10. ZORAPTERA.

Habitat.—Warm countries only.

Preservation.—In spirit, after fixation.

11. PSOCOPTERA.—Book-lice, Death-watches.

Habitat.—Widely distributed, but more abundant in temperate regions. Damp situations away from light are essential. Some species are to be found in houses, while every entomologist knows that collections of insects are much favoured.

Collection.—Spirit-brush method into a fixative; a few of the larger species may be taken with a net. Many may be obtained by means of the Berlese funnel.

Preservation.—Microscopical mounts. In addition to making slides, a few examples of the larger, winged species should be pinned from beneath through pith.

12. MALLOPHAGA.—Biting Lice, Bird Lice.

Habitat.—External parasites on birds or mammals.

Preservation.—In spirit, after fixation. Microscopical mounts. Eggs, attached to the feathers or hairs of the host, may be mounted with "Thymoplas."

13. DERMAPTERA.—Earwigs and a few parasitic insects.

Habitat.—Earwigs are nocturnal in habit, lying in concealment during the day.

Preservation.—Earwigs may be pinned, but the small species are best carded.

14. RHYNCHOTA (*Hemiptera*).—Bugs, Greenfly and Scale insects.

Habitat.—The majority of the *Rhynchota* are herbivorous, and most species of plants will yield a number of species.

Collection.—Sweeping and beating are the most profitable methods of obtaining these insects. The smaller species, such as the *Jassids*, *Cercopids*, *Aphids* and *Aleurodids*, are most easily taken by the spirit-brush method, particularly the immature stages. These smaller groups will, however, be discovered in great numbers when sweeping or beating. Time spent in pulling to pieces tufts of grass will not be

wasted. Many *Aphids* and *Psyllids* may be obtained by means of the Berlese funnel.

Preservation.—The larger species of *Rhynchota* should be pinned whenever possible ; the small species are best carded. The following points should be borne in mind :—

(*a*) Some specimens of each species should have the wings extended.

(*b*) Carded specimens should have the rostrum pulled forward, if possible. Some should be mounted dorsal surface to the card.

(*c*) Large species are pinned through the centre of the triangular scutellum.

(*d*) *Cercopids*, etc., should be pinned from below through pith ; they may also be carded.

(*e*) The nymphal stages of all but the large species are most satisfactorily preserved, after fixation, in spirit. Eventually microscopical mounts should be made.

(*f*) *Coccids* should be mounted microscopically, in such a manner as shall demonstrate the pygidium. The method required is described in a later section. *Coccids* keep very well dried ; the dried insects should be kept in envelopes, or they may be mounted with " Thymoplas," this last method being extremely satisfactory.

(*g*) In the case of *Aphids*, *Psyllids* and *Aleurodids*, unstained mounts are most satisfactory when "Euparal" is used. Examples of all species should also be cleared in potash, stained, and mounted in the usual way ; it is important that the antennæ be not damaged.

(*h*) Cast skins are a great asset to a collection of *Rhynchota*.

15. COLEOPTERA.—Beetles.

Habitat.—Widely distributed and to be found everywhere.

Collection.—The three most useful pieces of apparatus for the collection of *Coleoptera* are the beating-tray, the sweeping-net, and a strong trowel or pupa-digger. It is difficult to find anything more satisfactory than boiling water for killing the catches. Before pinning or carding they should be dried on blotting-paper. Small species will be discovered by means of the Berlese funnel.

Preservation.—The larger species (the size of an ordinary *Harpalus* and upwards) should be pinned through the centre of the upper half of the right elytron. Smaller

species should be carded. It is desirable that some specimens of each species be pinned or carded ventral side uppermost, in order that the under side may be examined. Owing to their soft integument the *Cantharidæ* should always be carded. *Meloidæ* require special treatment: the abdomen is removed, and the contents carefully rolled out with a penholder covered with blotting-paper. The abdomen is then stuffed with chopped cotton-wool and powdered naphthalene, care being taken that the resultant shape of the abdomen is as near correct as possible. Examples of the damage done by the wood-boring species should be collected, along with the insects, whenever obtainable.

16. STREPSIPTERA.—Minute insects, parasitic in the bodies of *Hemiptera* and *Hymenoptera*.

Strepsiptera should be fixed and preserved in spirit with their hosts. In addition microscopical mounts should be made. Three species, belonging to three genera, are found in Britain.

17. THYSANOPTERA.—Thrips or Fringe-wings.

Habitat.—Thrips are mostly herbivorous, and are commonly found in flowers and on leaves.

Collection.—Spirit-brush method, into a fixative. Berlese funnel.

Preservation.—In spirit, after fixation. Microscopical mounts. Some examples must be cleared in potash and stained before mounting.

18. ANOPLURA.—Sucking Lice.

Habitat.—Parasitic on the bodies of mammals.

Preservation.—Lice are best preserved in spirit after fixation; microscopical mounts may then be made. The eggs on the hairs of their hosts are most easily mounted with "Thymoplas." Variation in the class of mount is always advisable.

19. MEGALOPTERA.—Alder-flies, Snake-flies.

Habitat.—Alder-flies are to be found in the vicinity of water. The larvæ of Snake-flies breed under the bark of trees.

Preservation.—*Megaloptera* are pinned through the thorax and set in the ordinary way.

20. NEUROPTERA.—Lace-wings and Ant-lions. Some families fairly well represented in Britain.

Preservation.—The *Coniopterygidæ* (Mealy-wings) are too

small to be pinned satisfactorily; should pinned specimens be especially desired, they may be pinned from below through pith. It is essential that microscopical mounts of some examples be made. A number of specimens should be carded, in order to show the waxy powder with which the insects are covered.

Except for the *Coniopterygidæ*, the *Neuroptera* are dealt with in a similar way to the *Megaloptera*.

21. TRICHOPTERA.—Caddis-flies.

Habitat.—In the neighbourhood of water.

Preservation.—Caddis-flies should be pinned through the thorax, the small species being carded or pinned from below through pith. Whenever possible, examples of the cases constructed by the larvæ of the various species should be carded and placed by the perfect insect.

22. MECOPTERA.—Scorpion-flies.

Preservation.—Whenever possible scorpion-flies are pinned and set in the usual way. The wingless species are best carded.

23. LEPIDOPTERA.—Butterflies and Moths.

Preservation.—Full instructions have been given in the first part of this book, and it is far from necessary to go into the matter in any further detail. It might be mentioned, however, that eggs, pupæ and cocoons may be preserved extremely well with the aid of "Thymoplas."

24. DIPTERA.—Flies.

Habitat.—Flies are to be found everywhere.

Collection.—Flies will be taken in numbers with the sweeping-net or the beating-tray, also when on the wing. Many things will be found to attract various species of flies, such as dead animals, flowers and the like; baits of this character should be provided, or visited regularly if they are discovered, and many species will be found. Small species will be found when using the Berlese funnel.

Preservation.—The larger species of flies may be pinned and set; the pin should not be thrust through the centre of the thorax, but pushed through to one side. The hairs and bristles, on which the classification depends to a great extent, will only be destroyed on one side if this is done. Small flies may be carded or pinned through pith, in which case specimens arranged to enable the fly to be looked at from the side and from below are necessary. Empty puparia should be carded and placed with the perfect insects from which they have emerged. In the majority

of cases *Diptera* are most satisfactory if left unset. The addition of microscopical mounts of the smallest species to the collection is to be recommended.

25. SIPHONAPTERA.—Fleas.

Preservation.—Fleas are external parasites on birds and mammals. An examination of live animals and birds, or the dead bodies, before they have become quite cold, will lead to the discovery of many species. Fleas should be fixed and preserved in spirit; microscopic mounts may then be made.

26. HYMENOPTERA.—Saw-flies, Ichneumon-flies, Wasps, Bees and Ants.

Preservation.—Instructions have already been given in an earlier portion of this book. Microscopical mounts should be made of small *Hymenoptera*, such as the *Chalcidæ*, to supplement the ordinary collection. *Chalcidæ* and *Proctotrypidæ* will be found when using the Berlese funnel.

A SIMPLE METHOD OF USING MUSLIN FOR BREEDING-CAGES.

Breeding-cages in the form of a glass cylinder open at both ends are often used. The top end of the cylinder is closed by means of a piece of muslin, held in position by means of a rubber band or other device. If, however, a piece of muslin is thoroughly wetted, laid over the top of the cylinder and the loose edge firmly pressed on the glass, it will adhere as soon as it is dry. When the contents are examined the muslin is stripped off; after wetting, it can be replaced. This may be repeated a number of times, after which another piece of muslin may replace the first; or the starch, which attached it to the glass, may be replenished by dipping it in a little starch solution. It should be thoroughly dry before it is used again.

MICROSCOPICAL MOUNTING.

Microscopical mounting, as every advanced worker knows, is exceedingly complicated. Lee's 'Microtomist's Vade-Mecum' is certainly the finest text-book on the subject; it is, however, of a more advanced character than that required by those who wish to make simple mounts only. An attempt is made, in the next few pages, to set out a simple procedure which is the groundwork of all advanced microscopical technique. Owing to lack of space, sectioning cannot be dealt with in this appendix.

It will be noticed that very few staining methods are mentioned. Two commonly used types of stains are given, and further information must, by reason of the small space at the author's disposal, be looked for elsewhere.

Requirements for Microscopical Mounting.

The list of requirements given below is only intended to cover the needs of those who desire to make mounts of a simple character.

Glass-ware and instruments.

3″ × 1″ glass slides.

Square or circular coverslips, $\frac{1}{8}$″ diameter.

Watch glasses.

Fine forceps—two pairs.

Pipettes—three or four.

A pipette consists of a length of glass tubing drawn out to a fine point, a clear opening being left at the end. A rubber teat is then placed on the other end, so that liquids may be drawn into the tube and then expelled.

Several camel-hair brushes for transferring small, delicate objects.

Several fine needles mounted in wooden handles.

A few test-tubes.

Spirit-lamp or bunsen-burner.

Balsam bottle.

Reagents.

Glycerine.

Methylated spirit for making up various degrees of alcohol (*i. e.*, 50, 70, 90, and 95 per cent.).

Absolute alcohol.

Xylol.

Clove oil.

Canada balsam in xylol.

Potash.

Borax carmine.

Acid 70 per cent. alcohol.

Acid fuchsin.

Distilled water.

Directions for making up the stains will be found in the section devoted to formulæ at the end of this appendix.

Various Methods of Mounting.

These methods will be explained by taking examples to illustrate each class of mount and giving the details for their preparation.

A. *Clearing and mounting in balsam.* (Clearing in clove oil or xylol.)

(*a*) Without staining, *e. g.*, the leg of a fly. The stages are as follows :—

1. Place the object in a watch-glass and cover with 50 per cent. alcohol for about 1 minute.
2. Pipette off the 50 per cent. alcohol and replace with 70 per cent. alcohol. Allow to remain for about 3 minutes.
3. Change, as before, to 90 per cent. alcohol for about 4 minutes.
4. Absolute alcohol for about 5 minutes.
5. Equal parts of absolute alcohol and clove oil for two minutes.
6. Clove oil for 10–15 minutes. The time required for clearing will vary very greatly with the size of the object ; 24 hours or more may be necessary in some cases. Xylol may be used instead of clove oil, if it is particularly desired that the object shall not become brittle ; clove oil, however, usually gives better results.

(*b*) Stained. In the case of the leg of a fly, the muscles inside the leg may be shown by means of a suitable stain. In this instance borax carmine will be used, it being a good " plasma " stain.

1. As in " *a.*"
2. As in " *a.*"
3. The 70 per cent. alcohol is pipetted off and borax carmine added to cover the object. The stain should be allowed to act for about 10–15 minutes, but the time required varies according to the size of the object.
4. Wash out the stain with acid 70 per cent. alcohol, until the washings exhibit no pink coloration.
5. Rinse in ordinary 70 per cent. alcohol, to remove all traces of acid.
6. 90 per cent. alcohol for about 4 minutes, after which proceed as before, finally mounting in balsam.

B. *Clearing in potash.*

By this method the whole of the soft parts of the insects are removed by treatment with a solution of potash, only the chitinised portions of the insect remaining. It will be found the best procedure for mounting the mouth-parts of many insects, for larvæ and for any class of mount where only the chitinised portions of the insect are required. The stages are as follows :—

1. Wash the insect, or the portion of the insect, with 70 per cent alcohol, to ensure that it will be thoroughly wetted when in contact with the potash.
2. Prick the insect in some place where no harm will be done; the actual spot punctured will depend, to a large extent, on the purposes for which the mount is being made. The potash will now be able to penetrate and the broken-down tissues to escape.
3. Treat with potash solution. Robust insects may be treated by boiling with a 10 per cent. solution, but in the case of the more delicate species a 5 per cent. solution will be strong enough. Very delicate, or very small, insects are best left in a 5 per cent. solution of the potash for from 4–12 hours.
4. By means of a "seeker" or blunt needle, gently press out the contents of the insect. It may be found necessary to repeat the boiling process, but the whole of the contents of the insect must be removed before proceeding further.
5. Wash out the potash with distilled water. If desired, the washings may be tested with red litmus paper; it is perhaps as well that this be done in the case of very large insects.
6. 50 per cent. alcohol for 5 minutes.
7. 70 per cent. alcohol for 3 minutes.
8. If the insect, or part of the insect, is not highly chitinised, it is advisable to stain it. A good chitin stain is fuchsin, the results being much improved if a little picric acid is added to it.

   To stain, pipette off the 70 per cent. alcohol, and cover with the stain. Add a few drops of picric acid. This may be allowed to act for from 5–20 minutes.
9. Wash in 70 per cent. alcohol.
10. 90 per cent. alcohol for about 4 minutes.
11. Proceed as before, finally mounting in balsam.

Coccidæ may be mounted in the manner detailed above. A most interesting and full account, by E. E. Green, will be found in the 'Annals of Applied Biology' for May, 1914.

C. *Mounting of ovaries, salivary glands, and other internal organs.*

The alimentary canal, salivary glands and other internal organs of insects should, after dissection, be treated as follows:—

1. Fix in corrosive sublimate; the time varies from a few seconds to about 10 minutes. The object

should be removed from the corrosive sublimate as soon as it is opaque.

2. Wash thoroughly in 70 per cent. alcohol to which has been added a few drops of tincture of iodine.
3. Then proceed as set out in A (*b*) 3 and onwards, where staining by means of borax carmine is dealt with. Borax carmine is a suitable and easily used stain for this class of mount.

MISCELLANEOUS HINTS FOR MICROSCOPICAL MOUNTING.

1. Where the object to be mounted is rather thick, a few small pieces of glass of a convenient thickness may be used to support the coverslip at the sides. (See Fig. 10, which shows the method, as seen in section.)

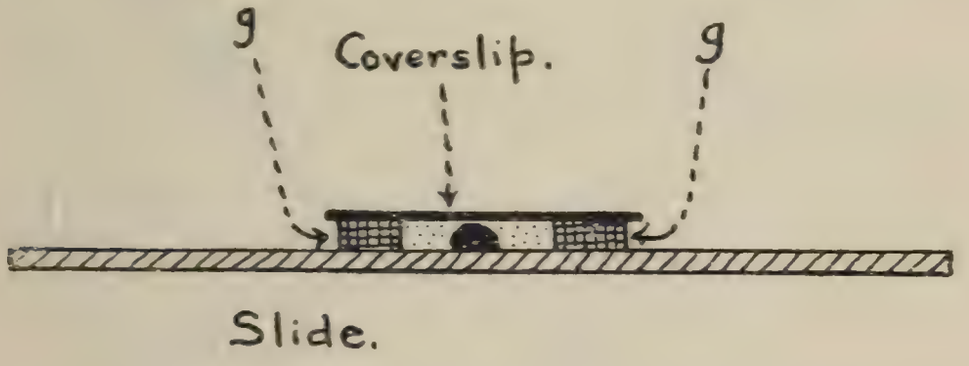


Fig. 10.

2. Small beetles, portions of larger insects, eggs and similar objects are conveniently mounted dry. If they are large, "Thymoplas" will be found the most satisfactory method. Very small objects, however, may be attached to a glass slide by means of gum tragacanth and a metal cell placed round them; this metal cell may be cemented to the slide by means of gold size. A coverslip of the same size may now be cemented to the cell and the whole ringed with Brunswick black as soon as it is dry.

3. All slides should be labelled and should bear particulars of the object, and of the methods by which it has been fixed, stained and mounted.

4. The actual mounting of an object in balsam, after all the necessary processes have been carried out, is as follows:

The object is placed in the centre of the slide; sufficient of the clearing agent (clove oil or xylol) should be present to prevent the object from becoming dry. Balsam is now

dropped, by means of a glass rod, on to the object; the quantity must be judged by experience. The coverslip is supported at one side by means of a needle and carefully lowered on to the object and balsam. In this way bubbles in the mounting medium may largely be avoided. (See Fig. 11, which shows the method as it would be seen in section.) Should a bubble be formed, it may be removed by warming the slide carefully over a spirit-lamp.

5. In addition to Canada balsam, there are many other mounting media. Of the permanent mounting media, only one will be mentioned here, namely "Euparal."

"Euparal" may be obtained from most dealers in micro-

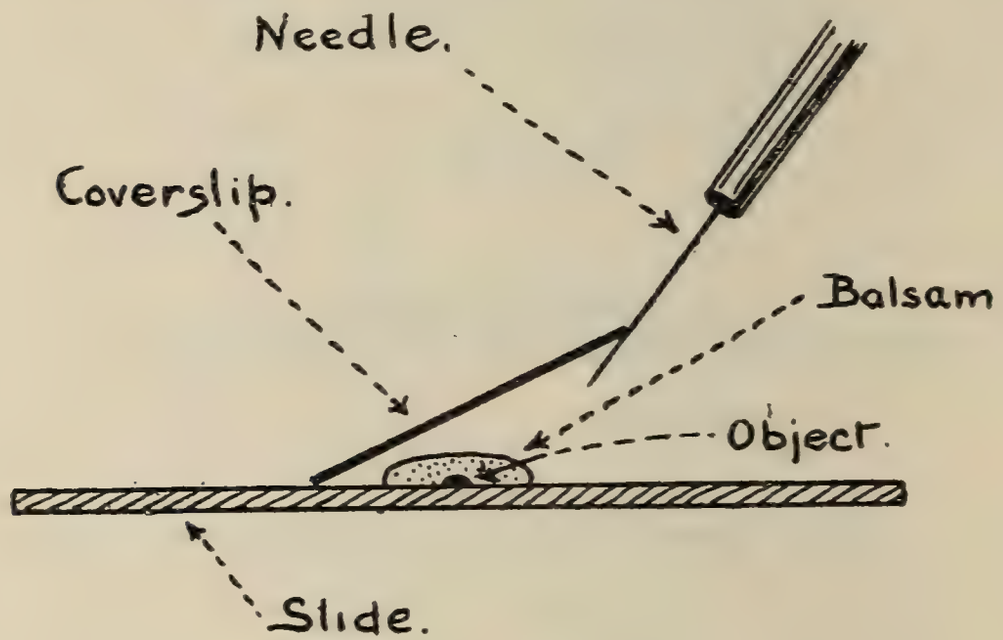


Fig. 11.

scopical materials, and has many advantages. The principal advantage of "Euparal" is that perfect dehydration is not a necessity, since objects may be mounted from 90 to 95 per cent. alcohol, and fairly good results can be obtained if only 70 per cent. alcohol is used. It is clear that the use of this medium renders the inclusion of expensive absolute alcohol, in the list of reagents, unnecessary. The refractive index of "Euparal" is lower than that of Canada balsam; the tendency is for an object mounted in this medium to exhibit more structure. The mount will dry hard in the same way as those made with balsam.

Glycerine is an extremely good medium for use as a temporary mountant. If it is decided, after an examination has been made, that a permanent preparation is desired, the object should be well washed in distilled water; the usual methods of mounting may then be proceeded with.

DISSECTION.

Every entomologist should be able to carry out a simple dissection for such purposes as determining the sex of an insect.

The instruments which will be found of the greatest service when dealing with insects are as follows :—

A fine scalpel, fine needles mounted in wooden handles, a seeker and fine forceps. Very efficient and cheap dissecting needles may be made by drawing out glass rod to a fine point. Some of the needles should be straight, others bent. It will be found an advantage if needles are made from clear and dark blue glass. Fine scalpels made from coarse needles, by grinding them down, are extremely useful.

Large insects must be dissected in a small dish, the bottom of which is covered with a mixture of paraffin wax and black lead ; the addition of lead shot will prevent it from floating when water is added, should the wax cease to adhere to the dish. The insect may be attached to the wax by means of fine pins ; or the surface of the wax may be melted and the insect pressed on to it. The insect should be dissected under a fluid ; the most suitable liquids are water, a mixture of water and glycerine, or salt solution. If the insect be rapidly rinsed with weak alcohol (say 30 per cent.), the dissecting fluid will wet the insect and prevent air bubbles from forming.

Very small insects should be dehydrated and thoroughly cleared in cedar-wood oil. They may then be dissected on a microscope slide. Cedar-wood oil does not render the insect brittle. Brittleness, however, is sometimes an advantage, in which case clove oil may be used in place of the cedar-wood oil. It is often an improvement if the insect is stained before transferring it to the oil, dissection being greatly facilitated ; Bismarck brown is satisfactory, as is also borax carmine in a lesser degree. Except in special cases, insects are dissected from the dorsal surface.

FORMULÆ.

Borax carmine.—4 grammes of borax are dissolved in 56 c.c. of distilled water ; to this is added 1 gramme of carmine ; to the liquid is then added twice its volume of absolute alcohol. Filter, and the stain is ready for use.

Acid fuchsin.—A 0·5 or 1 per cent. solution in 70 per cent. alcohol is the most convenient strength.

Carbol fuchsin.—Saturate a 5 per cent. aqueous solution

of carbolic acid with a concentrated alcoholic solution of fuchsin. A metallic-looking skin will form on the surface of the liquid when it is saturated.

Carnoy's fixing fluid (should be made fresh each time).—

Glacial acetic acid	1 part.
Absolute alcohol	6 parts.
Chloroform	3 ,,

Bouin's fixing fluid.—

Picric acid (saturated solution in water)	75 parts.
Formol	25 parts.
Acetic acid	5 ,,

Formalin.—The formalin (or formol) of commerce is a 40 per cent. solution of formaldehyde in water. For use it should be diluted with 10 volumes of water.

Gum tragacanth.—Place five or six small pieces of gum and a few small pieces of gum arabic tragacanth in about 25 c.c. of water. Leave for about 12 hours, when the gum will have absorbed the water and swollen. Then add half as much water and stir thoroughly. It should be not quite fluid.

Corrosive sulbimate.—Saturate a 0·5 per cent. solution of common salt with the sublimate. Corrosive sublimate is extremely poisonous and great care must be exercised in using it.

Acid 70 per cent. alcohol.—4–6 drops of concentrated hydrochloric acid is added to each 100 c.c. of 70 per cent. alcohol.

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